THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXV. No. 1937.] LONDON, JUNE 26, 1900. [52ND YEAR. PRICE 6d.

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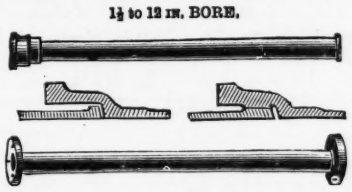

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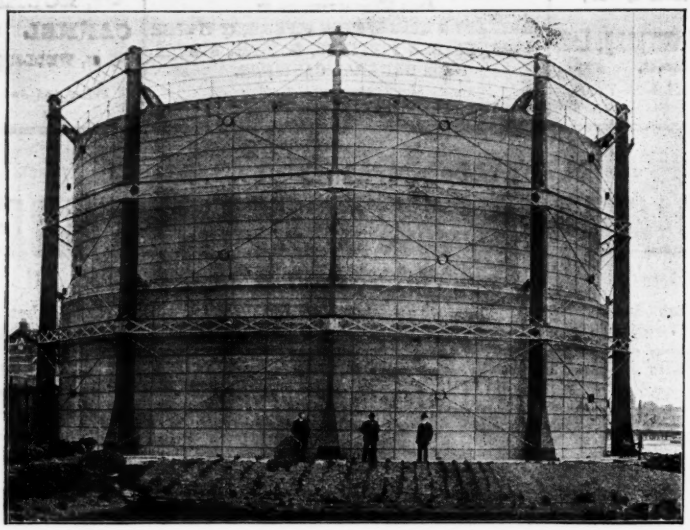

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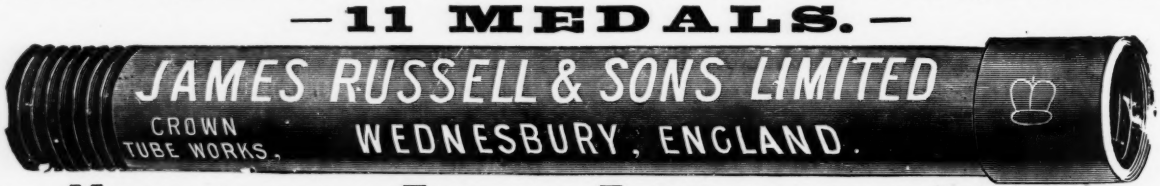

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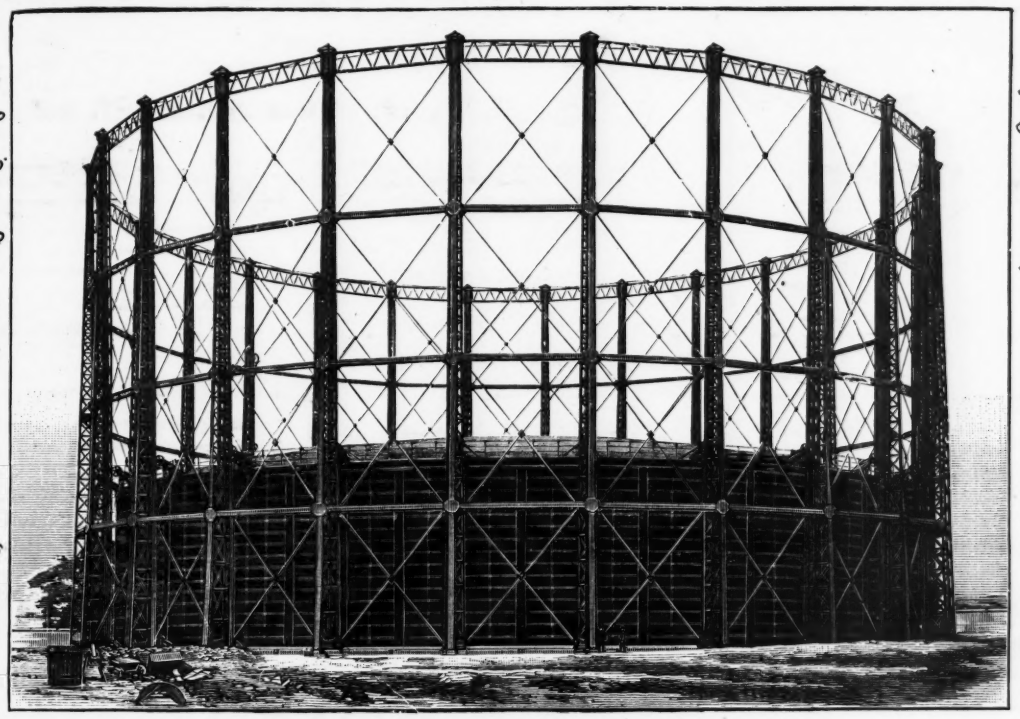

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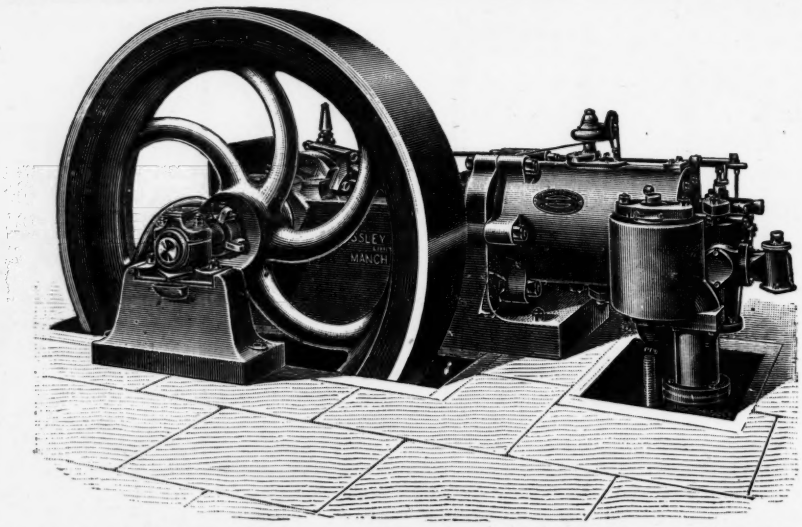

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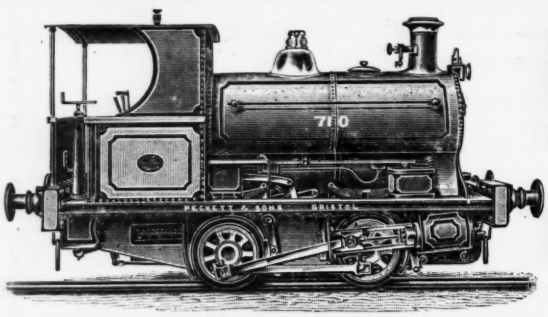

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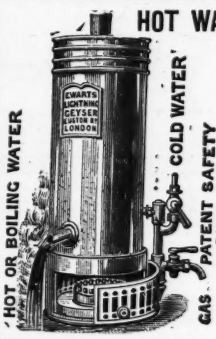

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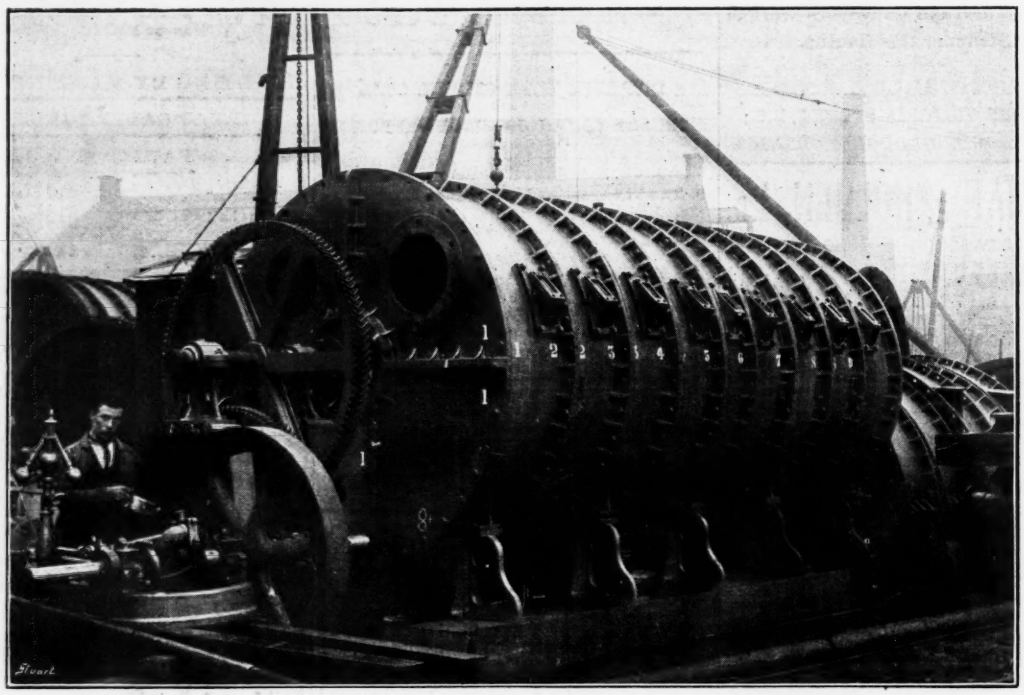

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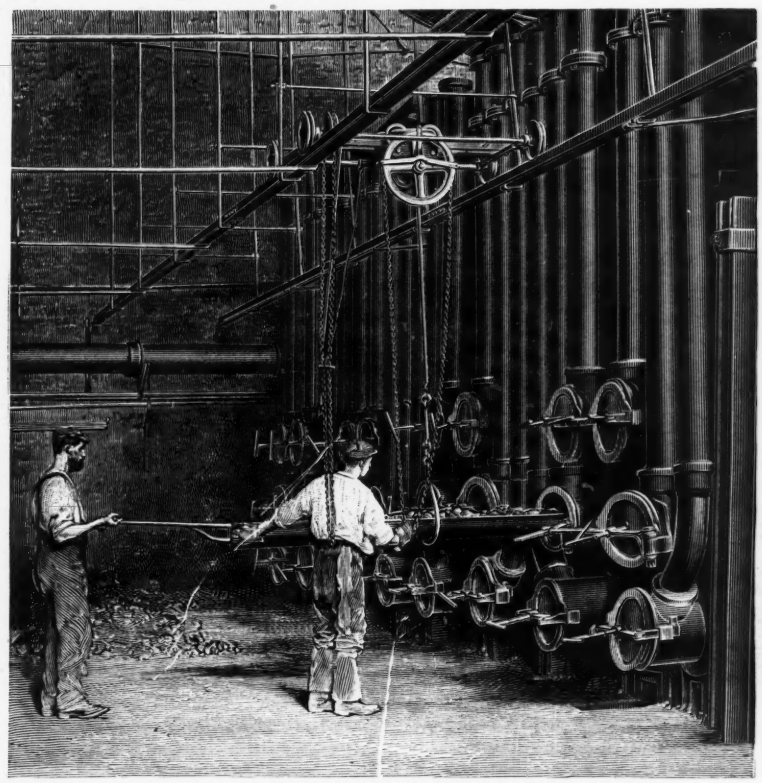

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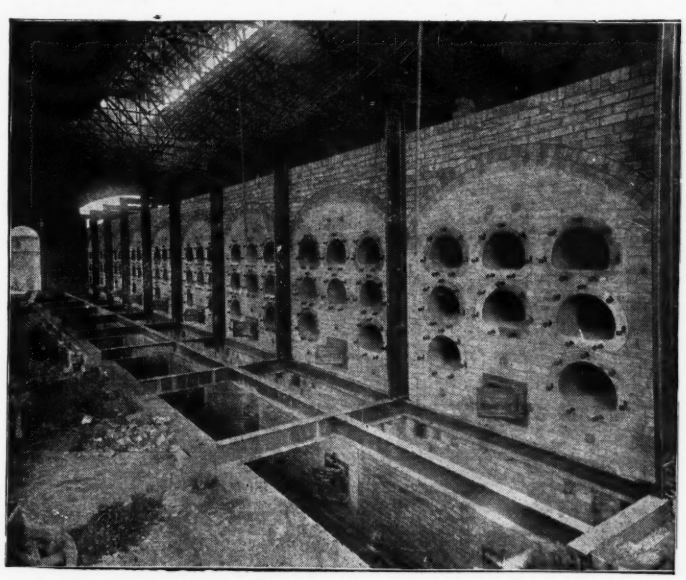

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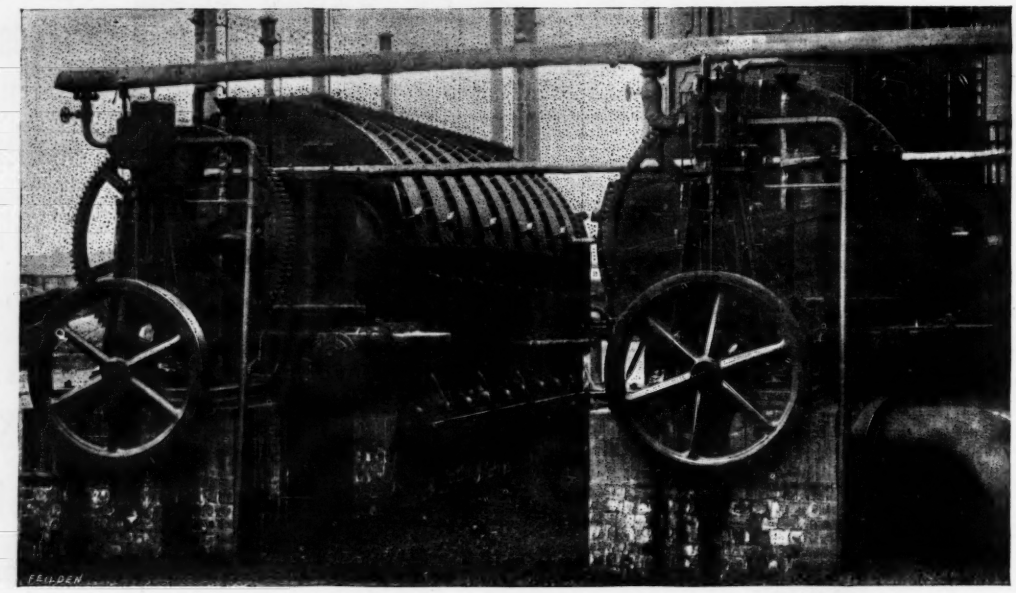

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Brussels	750,000	Shanghai	225,000	Rotterdam	850,000
Brussels (Second)	750,000	Stockport	600,000	Dorking	150,000
Liverpool	3,500,000	Norwich	1,000,000	McKeesport, Pa.	500,000
Liverpool (Second)	4,500,000	Holyoke, Mass.	600,000	G.L.&C.Co., Bromley	3,750,000
Tottenham	750,000	St. Joseph, Mo.	750,000	G.L.&C.Co., Nine Elms.	2,750,000
Tottenham (Second)	750,000	Lea Bridge	350,000	Durham	200,000
Santiago de Cuba	400,000	Lea Bridge (Second)	350,000	New York	4,000,000
Swansea	750,000	Stockton-on-Tees	500,000	Scarborough	800,000
Manchester	3,500,000	Edinburgh	2,000,000	Perth, W.A.	125,000
Brighton	1,750,000	Guildford	350,000	Bremen	550,000
Preston	1,400,000	Brentford	1,200,000	Maidenhead	225,000
New York	1,200,000	Syracuse, N.Y.	850,000	Epsom	225,000
Southport	750,000	Bridlington	150,000	North Middlesex.	150,000
Bath	1,000,000	Middlesbrough	1,250,000	Wandsworth.	1,800,000
Newburg, N.Y.	350,000	Croydon	1,250,000	Aarhus	800,000
Newburg (Second)	250,000	L. & N.W. Ry., Crewe	700,000	Falmouth	150,000
Hoylake	125,000	Taunton	225,000	Southampton	800,000

SINCE JANUARY 1ST, 1899.

Hartlepool	750,000	Brussels	1,000,000	Staines	600,000
Utrecht	1,000,000	Brighton (Second)	1,850,000	Commercial (Fourth)	2,000,000
Deventer	150,000	Stockport (Second)	600,000	Dublin (Second)	2,000,000
Portsmouth	1,000,000	Croydon (Second)	625,000	Faversham	200,000
Bournemouth	1,000,000	Maidenhead (Second)	225,000	Birmingham (Swan V'ge)	1,500,000
Aylesbury	150,000	G.L.&C.Co., Beckton	2,250,000	St. Gallen (Switz.)	225,000
Hamburg	1,750,000	G.L.&C.Co., Fulham	1,750,000	Colney Hatch	400,000
Redhill	275,000	Tottenham (Third)	350,000	Southampton (Second)	500,000
Dublin	2,000,000	Sydney (Harbour)	500,000	Tunbridge Wells	1,000,000
Posen	450,000	Sydney (Mortlake)	500,000	Hebden Bridge	200,000
Dunedin (N.Z.)	150,000	Manchester (Second)	3,500,000	Chorley	300,000
Lincoln	500,000	Hull	1,500,000	Liège	1,000,000
Antwerp	1,500,000	Longton	600,000	Stafford	500,000

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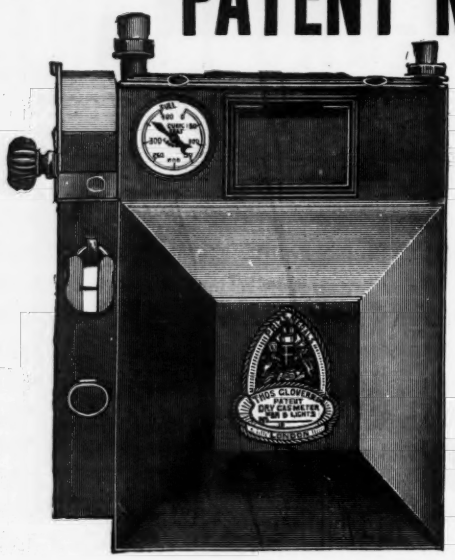

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EDITORIAL NOTES.

Rise of Price by the Gaslight and Coke Company.

THE announcement, of which we were able to give an early notice in last week's "JOURNAL," of an increase of 6d. per 1000 cubic feet in the price of gas to private consumers north of the River Thames of the Gaslight and Coke Company, cannot be said to have been unexpected. It nevertheless has created a considerable commotion in the London newspapers, which forthwith began to look into the matter. So little attention does the London newspaper press usually bestow upon Metropolitan affairs, that several of the leading journals were unable, on the spur of the moment, to tell an accurate story about the London Gas Companies and their doings. They mixed up the names and prices charged by the different Companies, and only agreed upon the point that the rise of price ordered by the Directors of the Gaslight and Coke Company, from 2s. 11d. to 3s. 5d. per 1000 cubic feet, is "scandalous," and not to be endured. The more sober-minded newspapers recalled the fact that the Commercial Company had previously raised their price by 6d. per 1000 cubic feet; while the South Metropolitan Gas Company had advanced theirs by 3d., making the selling price 2s. 4d. per 1000 cubic feet. Still, the patent fact that the net result of all these increases was to show more glaringly than ever the disparity of treatment of the consumers of the three Companies, could not escape acrimonious mention. The consideration that the high cost of gas coal may have had something to do with the increased price of gas, was not overlooked; and one London newspaper even admitted that the Metropolitan Gas Companies were doing no more than 150 Gas Companies and Gas Committees of Municipal Corporations throughout the country had been constrained to do before them. As will be seen by a report which we reproduce elsewhere, one newspaper promptly sent and "interviewed" Mr. George Livesey on the subject, and received the enlightenment which some others conspicuously lacked.

Notwithstanding all the uproar that the Metropolitan Local Authorities and the newspaper writers may raise over these increases, it is difficult to believe that the people of London, knowing that there are no "summer prices" for house coal this year, will be so unreasonable as to expect their gas to be made as cheaply as ever. As men of business, the majority of householders must realize that gas cannot, and ought not, to be kept at the same price while coal has risen about 7s. 6d. per ton in the last two years. Any Gas Company who could so disregard the cost of the raw material of manufacture, must have charged too much before—that is, of course, assuming that there is no specially advantageous contract in the case. In at least one important instance—Preston—the Company have actually been able to reduce the price of gas; for the simple reason that they are enjoying the benefit of a contract for coals made before the general rise, besides participating in the enhanced value of coke. Many other gas undertakings, for the same reason, are under no necessity to raise their price, and are not doing so. It is as well that the public should be early reminded of these facts.

At the same time, it is desirable to expose the fallacy of the argument, very popular just now in the newspapers, that the value of residuals will rise so high that the enhanced cost of coal will be set-off thereby, so that no increase of the price of gas is necessary. Apart from the obvious remark that no sliding-scale Gas Company, at any rate, would be so foolish as to sacrifice dividend needlessly, it should not be difficult to show even "the man in the street" that, while coke rises in sympathy with coal for comparatively small increments of value, it cannot, and does not, rise sufficiently to compensate for great advances, as of 5s. per ton and upwards, in the price of coal. Besides, all the expenses of gas making have increased enormously of late years, as every man in business must perceive from his own experience; so that when a sharp rise of the raw material of gas manufacture comes on the top of other swollen charges, there is no help for it but dearer gas. As it is, in no instance that we know of have Companies put up the price of gas to the full figure deducible from the actual rise in the cost of coal into the works. They have invariably given the public the benefit of the uncertainty as to how far the residuals markets will respond to the pressure on the coal supply; and if the pinch lasts any considerable time, further advances of price may be expected.

This is not the time to discuss the peculiar circumstances

that have brought the Administration of the Gaslight and Coke Company into such a pass that they have now to face much more than the ordinary amount of obloquy that might be expected to attach to a Company for merely putting up the price of gas 6d. per 1000 cubic feet. Their old enemies in and out of Parliament will rage more furiously than ever; and the official optimism of the Horseferry Road will ring more falsely than usual, on this "higher scale." A difference of 5d. as compared with the Commercial, and of 1s. 1d. per 1000 cubic feet as contrasted with the South Metropolitan Company, is not to be lightly passed over as forming part of the natural order of things sublunary. It is a very grave matter indeed, from whatsoever standpoint regarded; and it is difficult to forecast the course that will be taken with the object of correcting the inequality from without, as there is no sign of its reduction from within. One can only trust that injustice may not be done in the endeavour to deal with a hard case.

The Passing of the Morecambe Gas Bill.

THE Morecambe Gas Bill has passed through the Lords' Committee without further modification, and will therefore become law in the terms in which it left the Lower House. The only opposition offered to it in the Lords was in the interest of the outlying district of Heysham. The transfer of the Company's undertaking to the Morecambe Urban District Council is to be on terms which have been agreed upon by both parties; and, in accordance with established usage, a clause appears in the Bill enabling any outlying Local Authority supplied with gas to purchase their portion of the concern. In this case, however, Heysham desired to be empowered to sever from the Morecambe proprietary at a price calculated on the structural value of the plant taken over. Morecambe naturally objected to this proposal; contending that if Heysham were to be severed, it could only in fairness be on similar terms to those upon which they have agreed to purchase the undertaking as a whole. Heysham rejoined that, if Morecambe chose to pay an exorbitant price for the property, they should not be prejudiced thereby. The first question that arose before the Committee was as to the reasonableness or otherwise of the price that Morecambe had agreed to pay. Strong evidence was offered to the effect that the agreed price was fair. On the other hand, it was contended that the price was so high—throwing such a heavy capital burden on the undertaking—that the consumers of gas, especially in Heysham, would be worse off in future than they would have been if the Company had been left in possession. Still, the opposition failed to show cause why what is good enough for Morecambe is not equally good for Heysham; and the Committee declined to modify the severance clause in the sense asked for. Falling back on a second line of defence, Heysham asked for a clause similar to that inserted in the Glastonbury Bill for the protection of Street, which would give the outlying district the benefit of their rateable contributions to the sinking fund. Again the Committee declined to entertain the proposal. A last appeal for a direction that the gas profits should be applied to reduce the price of gas was also refused; so that, as above stated, the Bill went forward unaltered.

This precedent may be strongly commended to the careful study of municipalizers "on principle." Morecambe buys its gas-works, an admittedly fine property of the kind, at a very fine price. This is doubtless good business for Morecambe, which thus goes into a trade that is fast growing and extending. It so happens, however, that a good deal of this extension is in the outlying area of Heysham, which feels that it may be called upon to pay dearly for its gas in order that its neighbour may make a profit on the enormously inflated capital cost at which the undertaking has necessarily been acquired. Heysham may even consider that, but for the prospect of its compulsory assistance, Morecambe would never have consented to buy the gas-works at all. This shows the two sides of municipal trading for profit. Without going the length of approving of the original suggestion offered on behalf of the outlying district—that the Council should have the option of buying the local gas distributing plant, and severing themselves, at the "old-iron" value of the former—it is possible to hold that in such cases as the present the "outlanders" are somewhat hardly done by. The formal reservation to them of powers of purchase and severance is not enough protection. If they put them in force, in the majority of instances this means all the difference between supply by a small works and by a large one—that is to say, dearer gas. Many an outlying gas district has been constrained either to "cut off its nose to "spite its face," or to be exploited by another local authority. The rivalry, sometimes running to "bad blood," between neighbouring local authorities, is keen enough when they have no business relations with one another. Naturally, too; because it is usually a question of comparative rating. When to an existing cause of soreness which is perhaps congenital and unavoidable, is superadded a statutory right of one authority to relieve its rates partly at the expense of the other—and that the poorer suburban one—there is no wonder in these cases the "principle" of municipalization is differently esteemed in the two localities.

The Sapiency of the "London Correspondent."

IF that journalistic personage the "London Correspondent" of the "provincial daily" were only to write upon subjects with which he possessed some acquaintance, how often would he fail to send off the expected quantum of "copy"! Certainly anyone whose enlightenment upon the inwardness of metropolitan affairs was derived solely from the aforesaid personage's daily budget would, in not a few cases, be a blind follower of the blind. We are moved to these remarks by a paragraph which appeared in the "Western Morning News" last Friday, wherein the London Correspondent of that journal embodied such information as he possessed in regard to the increased price of gas in the Metropolis and elsewhere. We congratulate him heartily upon having succeeded in as completely demonstrating his ignorance of gas affairs as it would be possible for anyone to do in the space of something under thirty lines of print. After remarking that notices have been sent round intimating that the price of gas will be raised by amounts varying from 1d. to 13d. per 1000 cubic feet, the correspondent proceeds: "Most gas companies have fixed upon 6d. or "7d., it being alleged that this is the exact increase consequent upon the advanced price of coal. That is, fuel "has gone up 5s. a ton, which, it is contended"—mark this evidence of complete ignorance as to whether a ton of coal produces 10,000 or 50,000 cubic feet of gas—"is "equal to 6d. per thousand feet. This," continues the correspondent, as if to emphasize his want of knowledge, "may or may not be the case. But even if it "is, the Companies are evidently bent upon making "an additional profit to their already large surplus; for if "coal has advanced by that amount, coke and the products "of coal"—we might inquire if the writer imagines coke not to be a product of coal—"will increase, and therefore "the Companies will charge the consumers for the entire "addition to the price of coal, and pocket the increase on "the residuary products." We hesitate to put into print the only language in which it is possible to justly describe such a piece of unwarrantable misrepresentation, but will merely advise the proprietors of the journal in question to obtain from some Londoner of average information a statement of the true facts of the case, when they will certainly require their correspondent to withdraw an absolutely unfounded charge against the gas undertakings of the country. They will also probably give him some wholesome advice as to the dangerous character of a very little knowledge.

The conclusion of this precious paragraph is, we were going to say, more inaccurate and unfair than its commencement, but that would be unjust to the quotations we have already made. This is what we read: "In one part "of London the addition is deeply resented, because, some "time ago, in order to obtain new powers from Parliament, "the price of gas was reduced 1d., in consequence of the "protest against this Company charging about 50 per cent. "more than the other London Companies. *Having got its* "*powers*, it now increases the price by 7d." How anyone could obtain the one grain of accurate information contained in these grossly inaccurate sentences without learning sufficient of London gas affairs to prevent the writing of such an utterly misleading paragraph, we are at a loss to imagine. We venture to inform the proprietors of the "Western Morning News" that the Gaslight and Coke Company's Bill for new capital powers was rejected by the Committee of the House of Commons to which it was referred, and that the Company have given notice to increase the price of their gas by 6d. per 1000 cubic feet. For information upon such matters as the actual increase

in the price of coal, and the operation of the sliding-scale, we would refer them to the files of "The Times," and to the various Acts of Parliament relating to the supply of gas in the Metropolis. We should hope it will be long before they again allow their London Correspondent to allude to questions requiring for their treatment an elementary knowledge of the gas industry.

Municipal Loans and Fixed Prices.

THE London County Council are understood to be immensely proud of the success of their new financial policy, in issuing five millions of stock at a fixed price. Of course, the result will be applauded everywhere as evidence of the ability with which the Council transact their money matters, and also of the high point at which their credit stands in the City. It may be regarded as the carping utterance of a morbid detractor of this wonderful public body, but it is only common fairness to point out that the success of the issue is partly accidental, and partly due to an exceptional pliancy on the part of the Council as regards the taking of good advice and the following of an excellent example. Little as some may like to be told of the fact, the inaugurators in London of the system of issuing capital at a fixed price were the South Metropolitan Gas Company, whose Directors and Chairman were roundly abused for adjusting the bearing of their Act of Parliament in order to enable them to bye-pass the Stock Exchange, and get at the small investor in this way. Imitation, we all know, is the sincerest form of flattery. But even the willingness to copy a good model would not have ensured the success of the Council, if they had not at the last moment listened to the prompting of the Bank of England as to the right time for the issue. Just at the time of the brightening of the financial outlook generally —as that smart little journal, the "Londoner," observes— the Bank told the Council, "Now, or never!" There were just three days clear of crises. Pretoria had been taken, and the trouble in China had not then assumed importance. It was an interval of calm and confidence; and the County Council loan was subscribed for many times over. The success carries its own proper warning. It will not do for municipal authorities to hold themselves independent of outside financial advisers of the first consideration. It is recognized by the latter that the cheapness at which municipal loans could be obtained in the period from early in 1894 to the middle of 1896—the era of the birth and rapid growth of the modern idea of "municipalism" in local politics—was not due to the superior credit of the borrowers, but to the plentiful supply of loanable capital. Local authorities got money at 2½ per cent., and turned up their noses at the Public Works Loan Commissioners. They fastened upon the fond belief that 2½ per cent. was the fixed rate for municipal loans; and accordingly they set no bounds to the enterprises they could undertake with such cheap capital. In due course, however, came disillusionment. Certain municipal tentatives to raise money at the low rate failed; and now it is understood that first-class municipalities must be content to pay 3 per cent., if they want to make sure of getting money. It is a shock to feather-headed municipalizers, to discover that the value of money is a consideration in fixing the rate of interest on loans, as well as the nature of the security. When money is dear and the sinking fund has to be added to the rate of interest, the loans of local authorities do not cost them much less than the share and debenture capital of good companies—and there goes to the winds one stock argument for municipalization!

The Latest Dockers' Strike.

THAT egregious body, the Executive of the Dockers' Union, with Mr. Ben Tillett at their head, have chosen to call a strike of members of the Union employed at the London docks. The result will probably be the final disappearance of the so-called Union, and the cessation of its particularly useless and generally mischievous operations, which have chiefly consisted in the subsidizing of a handful of professional agitators. It is remarkable that even the "popular" newspapers have been chary of extending the usual "moral "support" to the strikers, while of material succour there has been none from any quarter. The ostensible object of the strike was simple enough—pay for dock labour at the rate of 8d. per hour, and "recognition of the Union." The world knows all about that "recognition" by this time. There were other minor claims; but the employers promptly went to the essential, and the misguided dockers had to leave their accustomed places and see other men taken on in their stead. The real reason for the outbreak was probably the conviction of the Union wirepullers that, as they had done nothing for many years to earn their salaries, unless they could show themselves to be of some use at this season of brisk trade, their paymasters would soon leave them in the lurch. Accordingly they staked their all upon the throw, and tried to make the strike effective by the usual course of lying to their own dupes and intimidating the free dock hands. The practical value of that "federation" of the ranks of Labour which one hears talk of occasionally, was early manifested by the decision of all the other "new" Unions not to strike in sympathy with their brethren the dockers, but to give them their good wishes. Of course, the Dockers' Union had no strike funds. The leaders had to pay their supporters with words, which, unfortunately for the latter, will not buy the beef and beer to which they are well accustomed in ordinary circumstances. The violence which was to have been expected as an accompaniment of the strike was unfortunately not prevented by the timely reinforcement of the dock police force, who are otherwise not a very efficient body; and this initial weakness really started the whole difficulty, as the strikers—in more than one sense of the term—fancied they were going to have their own way with their supplanters. Matters are different now; and the inevitable collapse of the strike is only a question of days. There is no force of public sentiment behind the revolt of these misguided labourers against their daily bread, as there was in 1889; and the sooner the men realize their folly, the better it will be for them.

The Cost of Accident Insurance.

WE have often urged in these columns that insurance against the liabilities entailed on employers by the Workmen's Compensation Act is the most costly method of meeting these liabilities; the preferable course being the adoption of a mutual scheme, as provided for in the Act. Additional point is given to this contention by the annual report of the Directors of the Guardian Assurance Company. The Company started an Accident Department some two years ago—mainly in view of the business likely to be done in connection with the Workmen's Compensation Act. Last year the accident premiums received amounted, according to the annual report, to £12,159. The accident claims figured at £7671, while the expenses of management and commission swallowed up no less than £3880. This allowed only a small surplus to be added to the amount carried forward to provide for special contingencies. While, therefore, it is obvious that—as such insurance business is conducted—the Guardian Company are not charging excessive premiums (the Directors, in fact, report that they consider them inadequate, but cannot raise them on account of the competition for this class of business), it will be seen that insuring against the liabilities of the Act involves paying annually about 50 per cent. more in premiums than would be sufficient to meet the liabilities if dealt with direct or through a mutual scheme. In other words, of every 30s. paid in premiums, 10s. goes to pay the expenses or provide the profits of the Insurance Company. This is a fact deserving of consideration by the gas industry.

Municipal Electricians and "Hospitalities" of Trading Firms.

BY a curious coincidence, the desire which has become a rooted determination on the part of the majority of British gas engineers and managers, to clear the membership and meetings of their technical societies from the merely commercial followers of the gas industry, has found an echo from the best wishers of the closely related profession of municipal electrical engineering. We call the coincidence a curious one, because at different times when the gas professionals have been struggling to raise the desirability of this particular piece of exclusiveness into a matter of settled and united opinion, they have been checked by the reminder that members of similar professions—notably the electrical engineers—had not the slightest objection to the meeting and mingling of men who follow their industry in all capacities, including the industrial and commercial. It now transpires that the municipal electricians, at least, have come under the lash of outside criticism which they would have escaped if they had been a little more reserved in this respect. Last week there was a meeting of the Municipal Electrical Association at Huddersfield; and the then current number of the "Municipal "Journal" had under its "Electrical Notes" a sharply-worded paragraph blaming, as a "lack of dignity on the

"part of municipal officials," "rather too prominent a "feature of electrical gatherings," consisting in "the accep- "tance of hospitality at the hands of contractors." Our contemporary goes on to remark that it has been unkindly whispered abroad "that some of our electrical engineering "firms who spent large amounts in entertaining their "technical friends, reap a rather undue advantage." The grammar of this passage is rather mixed; but that is part of its sting. It is mighty galling to be twitted thus by a scribbler who cannot even write good English. Without knowing what justification there may be for this aspersion on municipal electrical engineers—it could not have referred to the Huddersfield gathering, which it antedated—the lesson may be taken to heart by all ranks in the gas industry. It is not nice that such things should be sayable of any men holding official positions, and entrusted with the responsible management of other people's property. There's the rub! The Municipal Electrical Association is far more nearly akin to a gas managers' society than the latter is to the Institution of Civil Engineers, with which these associations are sometimes mistakenly compared, or than the former is to the Institution of Electrical Engineers. If there were any gas managers' association confined to men in municipal service, the companionships of electricians and gas engineers would be exactly on all-fours. This consideration of the character of the ownership of the property confided to electrical or gas officials is, of course, an unimportant accident. The point is that self-respecting men occupying positions of trust of this general kind should not place themselves in circumstances, or habituate themselves to associations, for which the censorious might and often do malign them.

WATER AND SANITARY AFFAIRS.

Blessed with an environment which affords scope for making a meeting of a technical society—especially an engineering one—a huge success, Mr. C. H. Priestley, the Corporation Water Engineer of Cardiff, was enabled, by the aid of willing co-operators, to cause the meeting of the British Association of Water-Works Engineers in Cardiff last week to be one of those events which live long in a man's memory. From the Mayor and Corporation to the youngest official in the Water Department, all did their part, in great or minor degree, to welcome, entertain, and assist the members of the Association who had honoured the respected chief of the department by electing him to be their President. And outside the municipal pale, the managers of noted docks, iron-works, collieries, and water-works opened their doors to the visitors with such freedom, that the latter found it difficult to give adequate expression to their gratitude and appreciation. The Council of the South Wales Institute of Engineers, too, placed at the disposal of the Association their commodious Lecture Theatre and various rooms for the meetings. The thoroughness also with which the new Secretary (Mr. Percy Griffith) had ploughed through the mass of routine work which is a necessary, and must be a harassing, concomitant of annual meetings of this character, deserves a word of praise; and during the meetings all the *minutiæ* attaching to his office received faithful attention—nothing was neglected, and success resulted.

Small in quantity, but of excellent quality was the technical matter dealt with within the Lecture Theatre of the Institute. The President's address is a practical exposition of a practical man's thoughts on a variety of topics which have claimed, and are claiming, attention in the profession. Unconsciously, we think, the President does scant justice to the inestimable work which the Water Companies have accomplished in bringing to the doors of the inhabitants of this country a plentiful supply of potable water. He acclaims the work of the municipalities and local authorities, and devotes a large part of his address to describing what they have done, and to citing big figures in proof. But all he has to say for the water companies is that "they have done good work in the past in "many places, and are still doing so in many others." Who, we may ask, were the pioneers in bringing about a satisfactory water-supply system in this country; who were the people who risked much to replace polluted wells, in which lurked unseen and insidious dangers, by a pure water service—a service (even in the very early days) convenient and almost absolutely certain, as against a laborious, an uncertain, and a questionable means of supply? The answer is the water companies. They it was who, long before the corporations or local authorities moved a hand, brought about a new state of things, which led to the reformation of the sanitary conditions of our country. It is true beyond doubt that the municipalities of half-a-dozen towns can now show works which, for boldness of conception and execution, may outshine any individual water undertaking of a company; but we can, and so could a municipal water engineer if he so chose, point to noble undertakings which have been conceived and administered with equal wisdom by companies, and in some cases in the face of contemptible opposition by local authorities. Therefore we say that the work of the companies, both in the past and in the present, is worthy of the highest respect and recognition, and should not be lost sight of behind the majestic works and figures which Mr. Priestley presents in his address.

The views of the President on the Welsh water scheme of the London County Council—and they are of special interest coming from a Water Engineer in Wales—are wise, assuming that London requires, or is compelled, to resort to Wales for water. If London has to go to Wales, the President is of opinion that it will be to the advantage of the Principality rather than otherwise, providing that "due regard is given to the requirements of the districts "from which the water is drawn, and that they are liberally "and fairly dealt with." It may safely be left to Parliament to see that the localities yielding the water are fully protected, even though, in the President's judgment, "no "adequate provision was made" in the London County Council Bill "for the districts from which it was proposed "to draw the water." That is a matter which when the day comes, if it ever does come, the Welsh authorities will, we fancy, find little difficulty in rectifying. The President does not by any means stand alone on the question of the provision of a duplicate supply of water to towns where it is possible to readily and cheaply secure such a supply; but apparently he has overlooked the paper on the subject which Mr. W. G. Peirce read before the Association about twelve months ago. A good case was made out by the President for standard patterns in connection with the use and manufacture of cast-iron pipes; and a few remarks on Water Boards in general, and the Derwent Board in particular, concluded an address which was much applauded by those who heard it.

There were only two papers read, but they were of excellent quality, and were on subjects upon which the members could freely discourse. One, which touched a sore point of many water engineers, was by Mr. F. J. Bancroft, of Hull. It was upon "The Rating of Water-Works," and was a finished study of this very intricate question. The second paper was by Mr. A. J. Jenkins; and it dealt lucidly with "The Relationship between the Cost of Water "Wasted and the Cost of Detection." A lecture on "The "Strength of Bricks and Brickwork" was a valuable contribution to the knowledge on the subject. Some further comments on the papers may be made as we publish them in future issues. Meanwhile, we will not say more than this, that the meeting was one from which the members went with very happy recollections, and a more intimate knowledge than they possessed before of Cardiff and some of its famous surroundings.

Post Office Delays.—There were throughout the country last week many complaints in regard to the serious delays that had occurred in the delivery of letters, book-packets, &c., in consequence of the moving of the Post Office sorting staff from St. Martin's-le-Grand to Mount Pleasant. The greatest confusion was on Tuesday, and therefore many of our subscribers were without their "Journal" that day and Wednesday morning. It is to be hoped that by this time the trouble is at an end, and that there will be no delay in the delivery of this week's issue.

The Composition and Determination of Cerium Oxalate.—This was the title of a paper read before the last meeting of the London Section of the Society of Chemical Industry. The authors—Dr. F. B. Power and Mr. F. Shedden, B.Sc.—gave details of examinations of several samples of the salt of different origins. In addition to the employment of cerium salts in the manufacture of incandescent gas-mantles, of which they usually form about one per cent., they are also used in pharmacy. The cerium oxalate of the pharmacopœias must, according to the authors, be impure. They proved that the true formula of the salt is CeC_2O_4, $10H_2O$. Lanthanum oxalate and didymium oxalate have similar formulæ; each containing 10 molecules of water.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-SEVENTH ANNUAL GENERAL MEETING,

HELD AT THE

ROYAL UNITED SERVICE INSTITUTION, WHITEHALL,

JUNE 12 AND 13, 1900.

Mr. E. HERBERT STEVENSON, M.Inst.C.E., President.

PAPERS READ.

AUTOMATIC STOKING AND INCLINED RETORTS.*

By WILLIAM R. CHESTER, M.Inst.C.E.

There have been many important advances made during the last twenty years in the direction of lessening the heavy and laborious work involved in hand-stoking; and perhaps in no department of gas-works' administration have the energies and perseverance of inventors met with greater success. Twenty-five years ago mechanical stoking was in the earliest stage of its infancy; the London stokers' strike of 1874 gave it a great stimulus; and shortly afterwards many schemes were devised for accomplishing by mechanical means what had always hitherto been done by the bone and muscle of the individual worker. In the edition of "King's Treatise on Coal Gas," published in 1878, will be found a description of no less than sixteen different types of stoking machinery—many of them admirably conceived, and the outcome of much thought and inventive skill; but out of the whole of them only two succeeded in planting themselves in other works than those in which they first made their experimental trials, and practically only two types are in existence to-day.

The writer was much interested in the subject at this period (1870-80), and personally examined most of the machines when they made their early trials, and himself spent many sleepless nights in the development of one of them, which, unfortunately, had but a short career, and resulted in nothing practical, except the loss of time and a good deal of money in a fruitless attempt to make it "gee when it wouldn't."

Inventors concentrated their attention on perfecting the mechanism for drawing and charging, and paid little heed to the transport of coal and coke to and from the machines. Consequently, there was little financial effect; and many engineers could never be brought to believe that mechanical contrivances could be devised to supersede hand stoking. The machines looked so cumbrous, and had to be made so powerful to accomplish the little a single man was able to do by his own muscular effort, that a comparison of the two always made the machine look ridiculous by contrast.

It was not until the necessity was recognized of bringing the coal to the charger (also by mechanical means), that machine stoking ever made any headway. The earliest success in this direction was achieved by Mr. West at the Maidstone Gas-Works, when he combined with his manual stoker a method of transporting the coal, also by mechanical means, from the store to the scoop used for charging the retort. This he did in 1874; and at the same time Mr. Foulis was at work on his hydraulic stoker at the Glasgow Gas-Works, using a different means of transport for the coal. Mr. Foulis took his scoops to the coal-store on a four-wheeled bogey, where they were loaded by hand, and afterwards brought back to the charging machine by pony traction. This was found to be a cumbrous and expensive process; and ten years later pony traction was abandoned in favour of mechanical transport. About the same time, or a little earlier, power was applied by Mr. West to his manual stoker.

The commercial success of both systems was dependent upon the transport of the coal; and in this respect they out-distanced all their competitors, one after another of which dropped out of existence, until to-day these two systems hold the field in honourable rivalry alone. They are now nearly as perfect as machinery can be made, and do the work of carbonizing in horizontal retorts smoothly, quickly, and cheaply. These machines have now outlived the age of ridicule, and they have undoubtedly come to stay. In every important gas-works throughout the country one or both systems may be seen in daily operation.

The successful development of the inclined retort has, however, opened up a much wider field for the employment of mechanical stoking, since they are applicable to the smaller works, and have an economical limit much lower than the power stoker. Half-a-million cubic feet a day is the utmost economical limit of the latter. At this output, the cost for labour will be quite equal to that of hand stoking; the additional charges for interest, wear and tear, and renewals having to be earned in the winter months.

In the case of inclined retorts, the limit of economical production is the employment of one full bed of retorts—say 100,000 cubic feet of gas per day at the time of the minimum output. This corresponds to a make of 60 to 80 million cubic feet a year, and brings within the range of mechanical stoking an enormous number of moderate-sized works, which, before the introduction of inclined retorts, were excluded from the advantages of mechanical stoking. The writer has both systems in operation—viz., the inclined retort and the power stoker with horizontal retorts, and both deal with the coal from the time it arrives in trucks on the works, through the various processes of carbonizing to the point where the coke is placed in trucks ready to leave again—the whole operation being performed by mechanical means.

Where the installation is of suitable magnitude, there is not much real difference in the cost of mechanical stoking between inclined and horizontal retorts; but the inclined system has the advantage that it can be successfully worked when the power stoker cannot enter the competition on account of the smallness of the works. The main object of this paper, however, is to describe an installation of inclined retorts recently erected, rather than to make a comparison between the working of horizontal and inclined retorts; and to explain the mechanical contrivances for dealing with the coal and coke, which make the installation the most complete of its kind in existence, and renders the process of carbonizing in gas-works as nearly automatic as possible.

The retort-house in which the installation has been erected is one designed and built by the late Mr. Thomas Hawksley, at the Eastcroft Gas-Works, about 45 years ago. It is 196 feet long by 50 feet wide inside, and formerly contained sixteen beds of regenerator settings, with 18 feet through retorts. The house was too narrow for even manual stoking machinery; but it is amply wide enough to permit the comfortable working of inclined retorts, and admirably adapted for such an installation.

The roof of the retort-house was taken down in the early part of 1899, and the walls raised to a total height of 46 feet from the ground line—being an increase of 21 feet in height. The arches of the settings were removed, and the division walls carried up to the required height, and again covered in by an arch built on the incline to suit the rake of the retorts. The producer and the regenerator flues were rearranged; the new setting being heated by one producer. The division walls being only 8 ft. 6 in. wide, it was not possible to get more than seven retorts in a bed; and these were set at an angle of 32° with the horizon. The retorts are 21 ft. 10 in. long measured on the incline, and taper from 20 inches wide at top to 22 inches at bottom, by 16 inches deep. The charge of coal is 8 cwt. for the through retort, or 180 tons for the whole house when on 6-hour charges.

The coal enters the works in trucks by a siding communicating with the Great Northern Railway. It is then dropped into a hopper fixed below the level of the rails, and passes through a breaker made strong enough to negotiate the hardest of the Nottinghamshire hard cannels. From the breaker it is elevated to a point in the middle of the retort-house, 53 feet above the ground line, and delivered into a push-plate conveyor for feeding the coal hoppers, either to the right or left of the elevator head. The breaker and elevator have a capacity equal to 25 tons per hour; so that the whole of the coal required for carbonizing in the retort-house during the depth of winter will be raised in the hours of daylight.

The push-plate conveyors are worked by gearing from the elevator head, and are fixed along the centre of the coal hoppers at the top, having a hinged door fitted to the bottom of the conveyor trough for admitting the coal into the centre of each coal-hopper. The doors can be opened or closed from the charging floor.

* Three separate sheets of illustrations accompany this paper.

In front of each bed of retorts is a coal-hopper, having a capacity equal to about 36 hours' supply. This is ample for the purpose, and will allow a clear day to carry out any repairs to the coal-breaker, elevator, or conveyor that may from time to time be necessary. Duplicates of all wearing parts are kept in stock, and only a very short time is required to replace a defective one. The coal-hoppers are fitted with sliding doors at the bottom, which can be opened and closed from the charging floor.

Underneath the coal-hoppers there is a single line of rails, 3 ft. 8 in. gauge, running from end to end of the retort-house, and upon which the travelling charger moves to and fro. There are two of these chargers, one for each half of the house; and each charger consists of a nest of three hoppers, each one of which is at a different level, to suit the three tiers of retorts. The respective hoppers have a capacity equal to a charge of 8 cwt. of coal, which they receive from the storage hoppers above, and deliver into the retort by the simple process of pulling a chain. This removes the catch by which a hinged door is kept closed; and upon the release of this, the coal at once slides down the retort and takes up its required position.

From the time the coal leaves the trucks until it is safely deposited in the retorts, it is not once touched by hand. This, however, is no new feature in connection with inclined retorts, as it is common to most new installations. There may be slight variations in the mechanism by which this result is accomplished, but the broad principle is the same in all, and the writer claims no particular merit for this portion of the apparatus. The principal novelty in connection with the installation lies in the method of dealing with the coke, and in thus carrying the process of carbonizing by mechanical means to its ultimate limit. Mechanical carbonizing usually stops at the point where the coal has been successfully dealt with, and when the coke is delivered into barrows or trucks to be afterwards stocked loaded or screened by hand. The writer has applied himself to this question of the manipulation of the coke, and has devised machinery for treating it from the point where it leaves the retort until it is stored or loaded into waggons or carts, sorted and sized, and made ready to leave the works in marketable condition.

In front of the retorts at the discharging end there are two push-plate conveyors, each moving towards the centre of the house, with the return chain carried overhead. The push-plates work in a cast-iron trough 27 inches wide; and upon the edges of this trough, which form the rails, a portable hopper and shoot has been devised to traverse the whole length of the retorts on wheels. This portable hopper and shoot is moved in front of the particular retort about to be drawn, and placed so that when the lid is opened the tar will fall on an inclined plate attached to one side and run down it into a bucket provided for its reception. By this arrangement, the tar is all collected, and afterwards disposed of as a commercial product; the lower retort mouthpieces being kept perfectly clean and free from this very troublesome and disagreeable nuisance. The hopper-shoot is then moved up a couple of feet, till the coke shoot is under the mouthpiece. Then the stopper is withdrawn, and the whole charge of coke is received into the hopper. It is partially quenched here, and then lowered on to the conveyor by the opening of a pair of hinged doors fixed to the bottom of the portable hopper. These doors are hinged in the centre, and open from the outer edges—thus protecting the links of the chain from receiving any coke falling into the conveyor. The coke is afterwards completely quenched by means of a hose-pipe as it passes forward to the foot of the elevator.

Another feature of this portable hopper-shoot is that instead of delivering the coke on to the conveyor, it will transmit it, while red hot, to the furnace. The coke intended for the furnace may be received from any particular retort, and afterwards be fed into any particular furnace where it may be most required. It is necessary with inclined retorts and a coke-conveyor to have some hopper arrangement of this kind, as the coke is otherwise discharged so rapidly from the retorts, especially from the upper ones, that it falls into a heap, blocks the conveyor, and cannot then be properly quenched. The conveyors run at a speed of 140 feet per minute, which is quite fast enough for the purpose. From both ends of the house, they deliver into an elevator fixed in the centre. This carries the coke up to the top of some overhead storage hoppers, and delivers it into a push-plate conveyor similar to those fixed in front of the retorts. This conveyor traverses the whole series of hoppers; and by means of sliding doors in the bottom of the trough, the coke can be dropped into any particular hopper in which there is room to receive it.

The coke-storage hoppers have a total capacity of 280 tons, or sufficient for two whole days' production of the two retort-houses. They are erected on columns and girders above the line of railway, at a sufficient height to permit the trucks to pass underneath. The hoppers are divided into fourteen compartments, and may therefore be used for different qualities of coke. To each compartment there are two sliding doors, which open on to a screen over which the coke passes immediately before it enters the truck. The screens are made with bars having spaces between ranging from 2 inches to ¼ inch wide. At first sight it would appear that this must result in considerable loss; but underneath each screen is a hopper for collecting the small coke and breeze which passes through. These hoppers are provided with a sliding door at the bottom; and by opening this, the small coke passes into a funnel and on to a band conveyor fixed under the centre of each breeze hopper. The band conveyor takes it forward to a push-plate conveyor, and this carries it back to the foot of the coke elevator, by which it again ascends to the top of the coke-hoppers and is delivered into a revolving screen. This separates the fine dust, and divides the remainder into smith's breeze, coarse smith's breeze, and domestic and ordinary coke. These various grades are also loaded into trucks over suitable screens; and in this manner the whole of the coke is put into trucks, in the very best marketable condition, without once being touched by hand throughout the whole process.

There is no apparatus specially provided for breaking the coke; a sufficient quantity of the smaller sizes is provided from the loading screens. If at any time more is wanted, the coke is loaded over the wider screens, and if less, it is loaded over the smaller ones. The screens are all interchangeable; and one size can be substituted for another in a few minutes. As the smaller sizes of coke command the highest prices, no drawback arises from the coke being knocked about in transit from point to point rather more than is the case when simply tipped from barrows in the yard.

Provision has been made for converting the second house to inclined retorts at an early date; the coke hoppers and the elevator being put down of sufficient size to deal with the products of the two houses.

The whole of the coal machinery (including breaker, elevator, and conveyors) is driven by a 30-horse power steam-engine; and the whole of the coke machinery (including elevator, conveyors, and revolving screen) is driven by a 12-horse power nominal gas-engine, working up to about 24-brake horse power.

The total cost of the installation is about £25,000. But deducting £5000 as representing the portion spent in making provision for the second retort-house, it leaves a net expenditure of £20,000 for the conversion of sixteen beds of horizontal regenerator settings into a like number of beds of inclined retorts, with all the necessary coal and coke machinery for automatic working. This gives a capital expenditure of £111 per ton of coal carbonized per day, or about 9s. per ton of coal carbonized per annum, assuming an average of 250 full working days. The total saving will be fully 2s. per ton of coal carbonized, or sufficient to recoup the whole outlay in about 4½ years of 250 working days. The aim of the design has been to make the whole process of carbonizing as nearly automatic as possible, and to reduce the laborious work of hand-stoking to a minimum.

The writer is well aware that in several works throughout the country something has been done in the direction of applying machinery to the manipulation and loading of coke; and some six years ago he put down a plant at the Basford Gas-Works for accomplishing this in a partial degree. The present installation is, however, unique in this respect: It is the first installation in existence where the process of carbonizing is mechanically carried through, from the reception of the coal on the works to the departure of the coke from the works in marketable condition—screened, sorted, and sized to suit the requirements of all classes of consumers.

Diagrams have been prepared to illustrate this paper, and these will no doubt make quite plain any point which cannot be followed from the writer's description of the working of the scheme. In some cases, it has been necessary to prepare models of parts of the scheme, where drawings were too complicated to show all the points which had to be con-

sidered in working out the details. These will no doubt be examined with interest by the members.

Samples of the various kinds of coke produced are on the table and may be inspected by the members.

Bottle No. 1.—Contains the fine dust, all of which has passed through a circular hole ¼ inch diameter, and for which there is a limited sale for concreting purposes; the residue being used for steam raising.

Bottle No. 2.—Contains fine smith's breeze, which passes through a circular hole 1 inch in diameter, but will not pass one of ¼ inch diameter, used for small forgings and general smith's use.

Bottle No. 3.—Contains coarse smith's breeze, which will pass through a circular hole 1½ inches diameter, but will not pass one of 1 inch diameter. It is used for heavier forgings and also for slow-combustion stoves.

Bottle No. 4.—Contains domestic coke, which has passed through a circular hole 2 inches in diameter, but will not pass through one of 1½ inches diameter. It commands a ready sale for house purposes.

In addition to these, there is the malting quality of coke, loaded over a screen with bars 2 inches apart, and ordinary coke, loaded over a screen with bars 1½ inches apart.

Discussion.

The PRESIDENT said the paper was extremely interesting, especially to those who had to do with large works. The more one could eliminate hand labour, the better; and Mr. Chester seemed to have carried this out as far as was possible at present. Perhaps at some future time there might be a different method of carbonizing gas. Nearly twenty years ago, his father suggested that there might be some other way of carbonizing adopted. But casting one's memory back for twenty years, he thought that the carbonizing of to-day was very little different, except with regard to the use of mechanical means; and in this direction Mr. Chester seemed to have gone about as far as could be done.

Mr. S. Y. SHOUBRIDGE (Sydenham) said they were all obliged to Mr. Chester for his interesting paper; and those who, like himself, had had to do with the development of stoking machinery, would sympathize with him in the troubles he had referred to. With regard to stoking machines, the writer said that to-day two systems stood alone in honourable rivalry. He presumed he meant in England, because in America and on the Continent there were machines which were equal, if not superior, to those in use in this country. He was told recently by an American engineer that, in a large number of gas-works in that country, there was a stoking machine which charged three retorts at once; and they all knew that the Ross rake, which was brought over here from America many years ago, was equal to any other rake in the market. The author said that half-a-million cubic feet a day was the utmost economical limit for stoking machinery. If the author meant by this that power stoking machinery could be used economically on a works having a maximum output of half-a-million a day, he was afraid he must disagree with him; for he did not think it possible to introduce power machinery on a works of so small a size. He probably meant that in a works where stoking machinery was applied in a large retort-house, it did not pay to use the machines when less than six beds were in operation; but if this were so, he must also disagree with him, because his experience led him to say that not less than twelve beds could be economically worked by power machines. They were all glad to find Mr. Chester a convert to the inclined retort system; and he congratulated him on the success he had achieved. He was quite right in emphasizing the great advantages of inclined retorts, and showing that the system was applicable to works of all sizes—the very largest, as well as the smallest—while stoking machinery was not applicable to works of small size. It was gratifying to him personally to see that the writer had adopted the form of charger and the taper retorts which he had introduced at Salford; and he should be glad to hear how he found the taper retorts answered in the matter of discharging. The writer said there was not much difference in the cost of working between inclined and horizontal retorts worked by machinery; and he had both systems at his works operating under similar conditions. But it would add greatly to the value of the paper if he would tell them what the cost of each was. The author said the installation he had described was the most complete of its kind in existence, and was unique in the fact that the whole process of carbonizing was mechanically carried through, from the reception of the coal on the works to the departure of the coke in marketable condition. But this was hardly correct. It was within his own knowledge that at Birmingham some ten years ago, at both the Saltley and the Windsor Street Works, this was done; and it had been done for some time also at the works of which he had charge at Sydenham. There were also a good many places in Germany, Denmark, Austria, and Belgium, and possibly elsewhere, where the same thing was done. The principal novelty in the Nottingham arrangement was the moveable hopper placed so that the tar fell on an inclined plane, and ran down into a bucket. This reminded him of some of the earlier installations of inclined retorts, where the tar was a prominent feature; but in the more modern ones, no tar was produced which could be collected at the mouthpiece. He imagined that something must be amiss with the heating or charging of the retorts, if tar was produced in any quantity. He could quite understand that the ingenious hopper-shoot was a necessity with this form of conveyor, because without it the coke would block the conveyor, and would not be properly quenched. The author, however, went on to say that it was necessary with all inclined retort conveyors to have some hopper arrangement of this kind; but this was hardly so. In the works under his control, they had a conveyor into which the coke was discharged direct from the retorts, with great rapidity, without blocking it in the least; and as the coke passed through water at one end of the conveyor, there was no necessity to catch it and cool it on its way from the retort to the conveyor. The writer said the conveyor ran at a speed of 140 feet per minute, which was fast enough for the purpose; but he thought there must be some clerical error there. He would also ask whether it would not have been simpler and cheaper to have delivered the coke into a revolving screen at the top of the hopper, and screen it all there first, instead of having to elevate a large portion of it a second time. He thought it must tend to the detriment of the coke and increased cost. The samples of coke submitted were interesting; but he should be glad to know what proportion of each kind was produced from each ton of coke delivered to the conveyor.

Mr. T. DUXBURY (Middleton) remarked that he had had some little experience in the working of inclined retorts. The author stated that half-a-million cubic feet a day was the utmost economical limit for mechanical stoking. He said that "at this output, the cost for labour will be quite equal to that of hand stoking; the additional charges for interest, wear and tear, and renewals having to be earned in the winter months." Now at Middleton they had an annual make of 120 million cubic feet, six ovens, and eight retorts in each oven, 20 feet long; and they carbonized 7 cwt. per retort, with six-hour charges. He found when they had three ovens of these retorts working, it cost 1s. 2d. per ton of coal carbonized for stokers' wages, taking out the coke, elevating the coal, and all charges appertaining to the stoking generally. With six beds, it cost exactly 1s. 2d. still; so that with nine beds it would cost the same, and with twelve working the same. It seemed to him that inclined retorts would be quite as economical on a large works as on a small, because when one had the whole six ovens in operation they were then working at the minimum cost for wages. If there were twelve ovens working, one had to double the men and have two gangs. They ought to be able to work with six, twelve, or eighteen ovens in operation at the minimum cost for wages. He agreed with Mr. Shoubridge that, when the heats were right, they had practically no tar on the lower mouthpiece. If the charge were improperly laid, or the heats were lower than usual, then there was rather a larger quantity of tar; but with ordinary working, there was very little indeed.

Mr. W. A. PADFIELD (Exeter) asked whether it was necessary to use a variety of coal, or whether they were confined to one sort, as he understood the inclined retort system was not so satisfactory in working off Durham coals. He agreed with the President that they were still following a rather crude method of manufacture. He was now engaged upon experiments which would, if successful, form the basis of a patent; and therefore he could not go into it. But there had been absolutely very little improvement made during the last thirty years.

Mr. T. O. Paterson (Birkenhead) asked how much Mr. Chester provided for wear and tear, because the working parts of the machinery were very considerable; and as a great deal of it was for carrying hot material, he thought the wear and tear would prove excessive. He also believed they might carry the use of machinery too far, as men must be provided to attend to it, and it might be that these men would cost more in labour than if the machinery were swept away. The application of machinery to deal with a portion of the coke twice over seemed excessive. With regard to the storage of coke, Mr. Chester said he had two days' storage; but this was of little use. What was wanted was something like two months' storage, as when prices were low it was not always wise to sell. If sales were forced, then the price would go down.

Mr. W. Whatmough (Heywood) said he observed that Mr. Chester put the saving at 2s. per ton of coal carbonized. Would he kindly say what was the cost previously for hand labour?

Mr. C. A. Craven (Dewsbury) did not agree with the writer of the paper that half-a-million cubic feet was the utmost economical limit; he had not found that to be so. He had found that there was considerable saving as compared with hand stoking in any quantity at or above the minimum. The saving was not quite so great at the extreme minimum or summer make; but, even then, it was an appreciable saving over hand stoking. As compared with the old labour, including the man who looked after the engine, his experience was that there was a very considerable saving indeed where they had in use a fair number of retorts. They had frequently carbonized at from 1s. 2d. to 1s. 2½d. per ton. But in summer the men could not be so profitably employed; and then the labour cost went up to 1s. 6d. or 1s. 7d. They found, however, that the average thoughout the year was about 1s. 4d.

Mr. Chester asked if Mr. Craven was referring to inclined retorts.

Mr. Craven said that at Dewsbury they had now worked with inclined retorts for nearly three years, with very satisfactory results; and if they were going to increase, as they would have to do sooner or later, they would continue the same system, as their experience had certainly been favourable to working with inclined retorts.

Mr. Chester, in replying, said that, owing to the discussion having been interrupted on the previous day, it had fallen rather short of what it might otherwise have been on a subject of such general importance. Most of the gentlemen who had spoken had somehow or other transposed the paragraphs of his paper, and had applied those which referred to stoking to the inclined retorts; and they had also confounded the minimum with the maximum make. What he said was that the economical limit—which meant the minimum limit—was, in the case of inclined retorts, 100,000 cubic feet per day, or equal to one bed of retorts; and the economical limit of power stoking was 500,000 cubic feet per day, or five times greater. Mr. Shoubridge, who opened the discussion, was a pioneer in connection with inclined retorts, as he believed he was the first to develop them into a real practical success. Up to the time of Mr. Shoubridge's installation at Salford (though he unfortunately got into trouble later on), there was no question that the inclined retorts which he then put up were of the most practical character which had been erected, and produced the very best results. Mr. Shoubridge was also to be credited with the invention of an apparatus for charging retorts which had been adopted in the case of Nottingham, and which Mr. Shoubridge had the modesty not to secure by patent. It was an invention which was well worthy of a patent; and he thought they owed a deep debt of gratitude to Mr. Shoubridge for having brought this piece of machinery to such a high state of perfection, while reaping no benefit from his labours and thought in working it out. Mr. Shoubridge asked why the whole quantity of the coke was not passed through the revolving screen, instead of being passed into the conveyor, and so save the trouble of dealing with the dust afterwards. The reason of this was that the revolving screen extended only to a portion, not to the whole, of the hoppers. The extent it covered was about two-and-a-half hoppers out of the seven; so that it would be impossible to use it for filling the remainder. The conveyor on the top running the whole length of the hoppers enabled the coke to be dropped into any particular one as might be required. Some question had been raised as to doing the work twice over, by passing the dust derived from loading the coke back again up the elevator and through the revolving screen. The object of doing so was this: All those who had had coke-hoppers for loading coke, either directly into trucks or into carts, would have met with the experience that the rough coke ran out while the fine breeze accumulated in heaps inside the hoppers. After a time, there was a rush of this small coke; and it would tumble into the trucks and spoil the whole marketable quality of the load. He had found this in connection with coke-hoppers, and had endeavoured to eliminate the difficulty in the present installation by providing that every particle which entered the truck must pass over a screen to remove the small *débris* and dust which would accumulate in the hopper. There was no loss thereby, further than the loss of the gas which was used in elevating it back to the top of the hoppers. Then all this small material went back and passed through the screen, and was put into the condition of a marketable material. He was not able to give the exact proportions of the different sized cokes that were obtained through the apparatus, because they naturally differed with the size of the screen over which the ordinary coke was loaded. If they used wider bars, they would get a larger proportion of sized coke; and if they loaded over narrower bars, they would get a less quantity. Mr. Duxbury seemed to have been dealing with a fallacy respecting the question of the economic limit. He said he found that by putting on more retorts he did not lower the average cost of making gas; but this, he thought, was contrary to all experience. Mr. Duxbury said that, with three beds of retorts, he had reached a certain economic limit. If he doubled the number, he did not get any decrease of cost; if he put on three more, he did not get any decrease; and if he put on three more still, he did not get any decrease—it was all multiples of three. But everyone knew that, in the unloading of coal, they got a very considerable decrease of cost if they increased the quantity; and the same thing applied to firemen's wages, to the engine man who was in charge of the gas-engine, to the whistle-blower or foreman, and to many other odd men. The wages of these men were the same whether they were working at the minimum or the maximum; and therefore, as they increased their output, they must naturally decrease the cost, and *vice versâ*. Mr. Padfield asked if they had any difficulty with regard to the creeping of the coal, or whether different kinds of coal made any difference in the successful working of the retorts. At Nottingham, they used something like thirty or forty different sorts of coal; and they were prepared to deal with any kind that was likely to come to them. He had heard of difficulties with regard to creeping, and so on, but had never met with them in any personal experience of his own. The amount of wear and tear which Mr. Paterson had referred to had not yet been ascertained, as the apparatus had only recently been put into operation; but he had no doubt in his own mind that it would not be a very excessive figure, because in the power stoking he found that the whole cost of the wear and tear in the coal portion and in the coke portion of the apparatus did not exceed 2d. per ton of coal carbonized. In this plant, he was perfectly sure it would be less than it was in the power stoking. They had in the coke hoppers practically two days' supply; and that was as much as was necessary in connection with this particular works. Of course, it was not all the coke storage room that one wanted. But they happened to have three gas-works at Nottingham; and this gave them the alternative of selling from one particular works, and putting into stock at another. In this way, they could work the matter to the highest economical advantage. If they wanted to store coke, they stored it at another works; and they could go on selling the whole of the production at this particular works, by reason of the economy of working. Mr. Whatmough had spoken of the cost of hand stoking as compared with this apparatus; and he did not seem to see where the 2s. was to come in. At Nottingham, hand stoking was rather an expensive process; and from the point where the coal went into the works to the point where the coke left it, it was quite 3s. per ton of coal carbonized. With this apparatus, they would be able to deal with it for 1s.; the difference being the amount referred to. He was glad to hear from Mr. Craven that he had found his installation of inclined retorts a great success. He did not understand that Mr. Craven dealt with the whole process from point to point; but he was able to do his carbonizing on an average at 1s. 4d. per ton. Mr. Craven, like Mr. Duxbury, had

somewhat mixed up the economical limits of the two processes; but the explanation was that the minimum of 100,000 cubic feet applied to the apparatus before the meeting, and the minimum of 500,000 cubic feet to the other apparatus.

RETORT-HOUSE ROOFS.*

By A. T. Walmisley, of London.

The chief roofs connected with gas-works are constructed over retort-houses and over purifying-houses. The former are generally erected entirely on walls, and slated; the latter are very often open both at sides and ends. Ample ventilation above the eaves is of primary importance in a retort-house roof; but generally speaking no glass is introduced in the covering, and very little sunlight admitted, except in some cases through the ventilator. The house may be adapted for either a single or a double stack of retorts, and may be of the ground-floor or stage-floor type of erection, according to the system of working adopted; the latter needing higher walls or a greater amount of clear headway than the former.

Suitable openings are usually provided in the walls for the admission of light and air, above the level of the retort-benches; and the ridge ventilator is generally made to extend from end to end of the building. Ventilating tubes or towers are sometimes added; and, in short, every effort is made in a well-considered design to provide roof ventilation free from wind currents at the sides of the building. In the author's paper read before the Institute in 1891, dealing with the effect of wind pressure on retort-house roofs and gasholders, he pointed out the fact that retort-houses were, as a rule, placed in sheltered positions, and that the strains produced in a truss fixed upon the side exposed to the wind were greater than the strains produced in a truss that was fixed on the lee-side only.

The site for a ground-floor type of house should present an exceptionally good foundation, in order that the foundation of the retort-stack may be laid at a depth of about 9 ft. 6 in. below the floor-line, and have an underground passage at least 7 feet wide in front of the stack. The clear space in front of a retort-stack should not be less than 18 feet. When mechanical means are adopted for charging and drawing retorts, 22 feet may be allowed.

The "Minutes of Proceedings" of the Institution of Civil Engineers (1898-99, Pt. IV.), Vol.CXXXVIII., contain an interesting article on "Labour-Saving Appliances in Gas-Works," by Mr. C. C. Carpenter, M.Inst.C.E., to which the author need not further here allude, beyond stating that mechanical stoking has created a necessity for wider spans, owing to the position of the charging machine, which prevents the handle of the scoop from getting within about 7 feet from the mouthpiece. Members will be familiar with the system of drawing and charging machines, made by Sir William Arrol and Co., in use at the Vauxhall works of the South Metropolitan Gas Company.

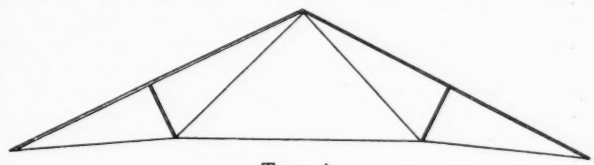
The inclined retorts at Kensal Green have an intermediate hopper fixed high enough to discharge into the charging hopper. This causes the height of the building to be greater than in the case of hand stoking. With sloping retorts, the span, as compared with horizontal retorts, is not reduced, since with the double arrangement usually introduced, a distance is left in the middle, sufficient to allow of the machinery for charging; and instead of a house containing one bench of 20-feet retorts, as with horizontal fixture, there are two benches of 20-feet retorts, the position of which also increases the height of the building. The floor in front of the stack is usually made to slope slightly towards the stack, and is paved with fire-bricks or other hard material. Preference is usually given to the stage-floor type in cases where the site naturally favours this construction.

The chief characteristic in a roof is its "principal," which may be of triangular, quadrilateral, segmental, or a combined outline. As a rule, retort-house roofs usually have a straight inclined surface, suitable for slate covering, and capable of discharging rain and snow in an efficient manner. It may be interesting to note, in passing, that 1 lb. of snow at freezing point requires 150 units of heat to melt it and to raise the temperature of the water obtained to 40° Fahr., and that this effect can be produced in $3\frac{1}{2}$ lbs. of snow (which is the usual weight allowed per square foot) by the consumption of 1 cubic foot of coal gas. The approximate weight of the kinds of slating used are as follows:—

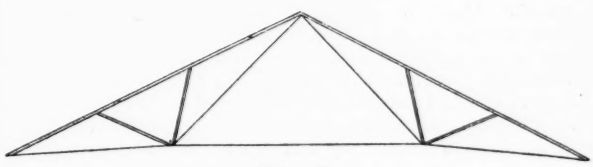
Ladies, 16 in. by 8 in.	5	cwt. per square.
Countesses, 20 in. by 10 in.	$5\frac{3}{4}$	,, ,,
Duchesses, 24 in. by 12 in.	6	,, ,,
Queens, irregular sizes, about 30 in. by 20 in.	8	,, ,,
Imperials, 30 in. by 24 in.	10	,, ,,

They can be fixed directly on angle-iron laths or Z iron bars, without the introduction of woodwork, by means of lead pegs or copper or zinc clips. The angle usually given to the rafters averages 1 in $1\frac{1}{2}$, having a rise of one-third of the span; and this inclination gives an angle of 33° to 34° with the horizontal.

The following Types A to H present the forms usually adopted; and from them it will be seen that the variation and the applicability of each form of principal are mainly



Type A.



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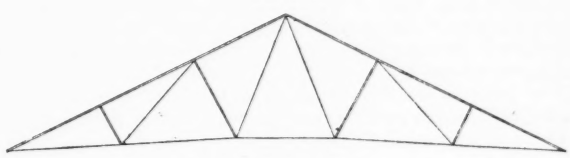
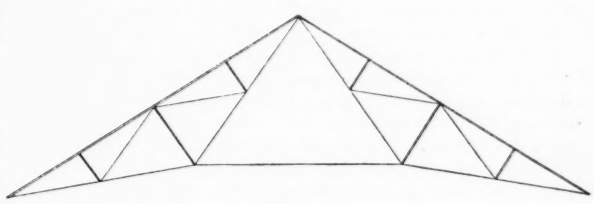
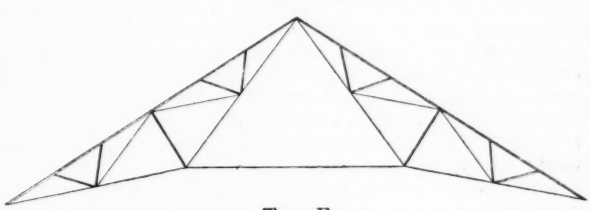


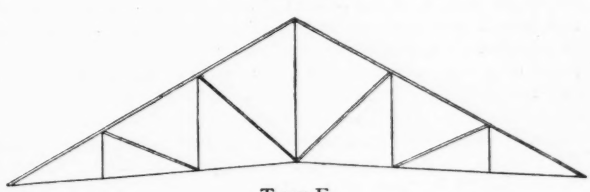
Type C.



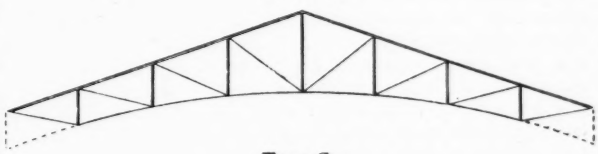
Type D.



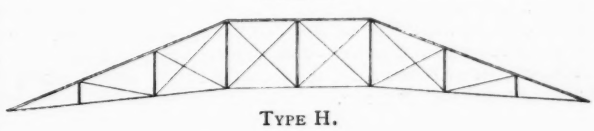
Type E.



Type F.



Type G.



Type H.

* Three separate sheets of illustrations accompany this paper.

ndicated by the number of sub-spans, and divide themselves into two classes—(1) those in which a brace radiates from one or more central points in the truss to each otherwise unsupported point, as in the case of each side rafter to Types A and B; (2) design in which the braces in a truss divide the same into a chain of triangles in a zig-zag fashion, as in Types C and G, but in each type designed to transmit the strains produced at intermediate points to the end supports.

The South Metropolitan Gas Company have a coal-store at East Greenwich of 30 ft. 4½ in. span, formed of a truss with braces radiating from a point in the centre line. The distance apart of the principals is 7 ft. 7½ in.; and the rafters are formed of T-iron 3 in. by 3 in. by ½ in., with T-iron struts 2½ in. by 2½ in. by ⅜ in. Inclined tie flat-bar 2½ in. by ½ in., with central king-rod 2 in. by ½ in. At the connection of struts and ties to the rafters, ½-inch plates are provided. Over some of the bays ventilation is furnished by a raised ridge; but over other bays, the whole covering is raised by means of T-iron standards and cast-iron louvre plates. The roof is 427 feet long, and is slated.

Type A is equally serviceable for large or small spans, and supports the rafter in a central position. Type B is of the same kind, but supports the rafter in two intermediate points. Type C also supports the rafter in two intermediate points, and resembles Types A and B in having the struts perpendicular to the rafter, and in having no vertical members. But otherwise it approaches the type of roof in which verticals are introduced in its general zig-zag arrangement of parts and details of connection. Type D is similar to Type A, but with longer rafters doubly trussed. Type E is the same as Type D, except that the rafter is here divided into six parts, instead of four. The use of either of these types depends upon the distance apart adopted for the purlins and support of the ridge ventilator. The struts are short, and the main part of the bracing is in tension. So far the system is all that can be desired; but in the case of roofs hipped at the ends, or roofs in which vertical longitudinal bracing between the principals is required, the type of roof shown in Type F adapts itself more economically, especially where the span of the roof is made to be a multiple of the distance apart of the principals or of the longitudinal width of the hipped bay. This type is largely employed for covering retort-houses.

Type G may be said to possess the advantage of a curved shape of tie, coupled with a favourable angle at its springing, in regard to the direction of a vertical re-action at the point of support. The lower portions, shown dotted, do not actually form part of the truss, but are added to contribute a vertical braced connection to the walls or columns supporting the roof. Type H, compared with Type F, provides a more perfect stiffening of the rafter at its foot, caused by the shorter intervals between the supported points, and presents a suitable framework when, as in retort-house roofs, the covering must be interrupted to allow ventilation. By the adoption of Type G or H, an angle of considerable magnitude at the springing is combined with the advantage of a moderate depth in the centre of the truss.

The dead-weight of a structure increases with its span. A weight of 8 cwt. per square is regarded as ample to allow for a roof of 60 feet span, or 10 cwt. for a span of 100 feet, if intended to carry slates on boarding. In roofs of 100 feet or less span, there is no economy in making the parts of steel. As stated by the author at the Institution of Civil Engineers in a discussion upon a paper on "Steel for Structures" ("Minutes of Proceedings," Vol. LXIX.), in 1882, "Sections of iron and steel adapted for roof purposes were comparatively so small that an error in the position of the holes became serious; and he thought that, in the adaptation of steel for roofs, it would be decidedly preferable to drill the holes." Steel, however, is now so generally employed that, provided the sections are not cut too fine and an ample margin of safety allowed, its success is established by employing satisfactory tests.

Figs. 52 to 57. The roof over the passenger station at Sittingbourne is an example of Type C, and a good form of a roof with open sides and ends. The principals are 12 ft. 6 in. apart, and 70 feet span, having a rise or depth at centre of 14 ft. 9 in., with rise of tie-rod 3 ft. 6 in. The slope of the rafter is 22°, and the area covered 200 feet in length. The cast-iron purlins are fixed so as to act as ventilators, and are 10½ inches deep.

Figs. 22 to 30. The roof at the Bow Common station, designed by Mr. G. C. Trewby, M.Inst.C.E., Engineer of the Gaslight and Coke Company, consists of seven main principals and six intermediate rafters, covering an area of 129 ft. by 57 ft. 6 in., enclosed by brick walls with openings for doors and windows. The main rafter consists of a T-iron 5 in. by 5 in. by ½ in., with a rise of about one-fourth of the span. The ventilator extends the whole length of the roof; and the distance apart of the main rafters is 18 ft. 8 in. The purlins here employed are of the arched lattice form, span 18 ft. 6 in., depth at centre 18 ft., depth at ends 3 ft., having flanges of L-iron 3 in. by 3 in. by ⅜ in., bracing-bars 2 in. by $\frac{5}{16}$ in. by ⅜ in., connecting the plates. The roof is slated over L-iron intermediate purlins 3 in. by 2 in. by $\frac{5}{16}$ in. placed 10½ inches apart, and has a slope of 25°.

Figs. 69 to 72. Another example of Type C is given in the roof over the Newcastle and Gateshead Gas Company's retort-house, having a clear span of 97 ft. 8 in. The total height of the trussed rafter above the springing line is 28 feet, and the rise of the centre horizontal portion of the tie beam is 6 ft. 3 in. The trussed rafter is composed of lattice work, formed by bracing-bars 5 in. by ½ in. between the top and bottom flanges of two angle irons 5 in. by 5 in. by ½ in., depth 3 feet, with web-plate at the springing of the truss, and at the connection of the purlins. This braced member is curved vertically round at the supports to form a level bearing upon a cast-steel base-plate. The lower tie beam is of two L-irons 5 in. by 4 in. by ½ in. with web-plate 12 in. by ½ in.; and the bracing-bars to the truss are each of two C-irons 6 in. by 2 in. by ⅓ in., with distance washers and bolts 2 feet apart. Slating laths 2 in. by 1½ in. by ¼ in. L-irons 10½ inches apart support the covering. The roof was erected by Messrs. Ashmore, Benson, Pease, and Co., of Stockton-on-Tees.

Figs. 63 to 66. Type D is illustrated by the roof over the retort-house at Folkestone, designed by Messrs. Thos. Hawksley and Son. The principal consists of T-steel rafter 6 in. by 6 in. by ½ in., with struts of T-steel 3 in. by 3 in. by ½ in., and rolled steel joist 4 in. by 3 in. by ⅜ in. The tie-rods are 2½ in., 1⅝ in., 1½ in., and ⅞ in. diameter. The span is 60 ft. 9 in., with a rise of 13 feet from the springing line to the central bolt in the rafter; and the rise of the tie-rod in the centre is 2 ft. 6 in. The roof is slated over L-steel purlins 1½ in. by 1½ in. by ¼ in., placed 10½ inches apart. In this design, it will be observed that coupling nuts are used with a cotter joint at the springing.

Figs. 40 to 51. Another example of Type D is furnished by the roof over the retort-house at Grimesthorpe station, designed by Mr. Fletcher W. Stevenson. It consists of 44 principals of 70 feet span, having a slate covering at an angle of 30°. The depth of truss is 18 feet, and the rise of the tie-bar 4 feet; making a total rise above the springing line of 22 feet. The height of the springing line is 32 feet above the stage floor, which is 12 feet above the ground level. The roof is carried by brick walls on either side; and the rafters are composed of 5 in. by 5 in. by ⅝ in. T-steel, with struts of I section 4 in. by 3 in. by 14 lbs. and 5 in. by 5 in. by 24 lbs. The inclined tie-bars are 4 in. by ⅝ in., and the lower tie-bar 6 in. by ⅝ in. The ventilator consists of two cast-iron girders or purlins 2 feet deep of ¾-inch metal, connected to each principal by means of separate cast-iron gussets or brackets of the same thickness. The width of the ventilator in the clear is 7 feet. The main purlins are of 5 in. by 5 in. by ½ in. L-steel. Longitudinal tie-rods 1½ in. and 1⅛ in. diameter connect the feet of the longest struts in each rafter; thus giving great rigidity to the whole roof.

The roof over the retort-house at the Luton Gas-Works, designed by Mr. W. R. Phillips, and erected by Messrs. S. Cutler and Sons, consists of seven wrought-iron principals to Type D, of 80 feet span, formed of rafters two L-irons 6 in. by 3 in. by ½ in., main struts two T-irons 5 in. by 2½ in. by ½ in., intermediate struts two T-irons 4 in. by 2 in. by ½ in. Inclined tension flat bars 6 in. by 1 in., 6 in. by ⅜ in., 6 in. by ¾ in., and 4½ in. by ¾ in. with king-rod 1 inch diameter. The purlins are 1¾ in. by 1¾ in. by $\frac{5}{16}$ inch L-iron, 8½ inch centres, and the longitudinal tie-rods between principals are 1 inch diameter. The ventilator, 10 ft. wide by 3 ft. 6 in. high, is carried upon six principals, consisting of one centre and two side cast-iron standards, with rafters 3 in. by 3 in. by ½ in. T-iron.

A roof of the form shown in Type E covers the retort-house at the Crystal Palace District Gas Company's works, designed by Mr. Charles Gandon, and erected by Messrs.

Ashmore, Benson, Pease, and Co. The clear span between the walls is 75 ft. 9 in., depth of truss 16 feet, with rise of tie-rod 2 feet, giving a total rise of roof above the springing line of 18 feet. Rafters T-iron 6 in. by 6 in. by $\frac{11}{16}$ in. Inclined tie-bars, 6 in. by $\frac{1}{2}$ in. and 3 in. by $\frac{11}{16}$ in., with lower tie-bars 7 in. by $\frac{11}{16}$ in. and 4 in. by $\frac{11}{16}$ in. Struts L-iron 4 in. by 3 in. by $\frac{1}{2}$ in. and 3 in. by 3 in. by $\frac{1}{2}$ in. The ventilator has cast-iron ridge plates, connected to the rafters by continuous L-irons 6 in. by 4 in. by $\frac{1}{2}$ in., and has a transverse width of 3 feet. The roof is slated.

The favourite type of truss for retort-house roofs appears to be that indicated by Type F. There are two roofs of this type at the Ramsgate Gas-Works, designed by Mr. W. A. Valon, and another at Tottenham (the distinguishing feature of the latter being Z-iron slating bars), erected by Messrs. S. Cutler and Sons. This form is sometimes quoted as a queen-rod roof; the term "queen-rod" being applied to the suspending rods which act as vertical ties to the feet of the inclined struts. In the roof over the retort-house at the Dublin Gas-Works, designed by the late Mr. Jabez Church, the principals are 64 ft. 3 in. span, placed about 6 feet apart, and the foot of each rafter abuts with cast-iron shoes, to which the tie-rod is connected. The depth of the truss is 20 feet, and the rise of the tie-bar 5 feet above the springing. The oblique struts and vertical ties have jaws or forks at their upper ends, where they are hung from the rafters by means of pins and screw ends; and at their lower ends they are connected with pinching nuts. The length of the roof is 296 feet, and includes a ventilating shaft in the centre of its area.

Figs. 31 to 39. An excellent example of this type of roof exists at the Litchurch works of the Derby Gas Company, designed by Messrs. T. Hawksley and Son. The principals are 52 feet span, with a rise of 9 ft. $4\frac{1}{2}$ in. from the springing line, formed of T-iron rafters 6 in. by 5 in. by $\frac{7}{16}$ in., and inclined struts T-iron $2\frac{1}{2}$ in. by 3 in. by $\frac{1}{2}$ in. and 2 in. by 3 in. by $\frac{1}{2}$ in. The vertical suspension rods are $1\frac{3}{8}$ in., 1 in., and $\frac{7}{8}$ in. diameter. The roof is slated upon purlins $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $\frac{1}{4}$ in. L-irons placed 10 inches apart, with eaves gutter of lead bedded in the stone coping. The ventilator measures 9 ft. 6 in. by 1 ft. 11 in. deep.

It will be seen, by reference to figs. 31 and 35, that the vertical tie-rods are connected to the rafters by means of cotter-joints, hence avoiding the introduction of coupling nuts. The struts and ties have independent bolt connections, likewise the horizontal tie-rods (see figs. 38 and 39). This method reduces the width of the connection, but necessitates the use of packing-pieces. In the roof over the retort-house at Folkestone, described above, each tie-rod and strut is furnished with independent bolt connections, as shown in the detail at C (fig. 63). At Sittingbourne Station the struts are of flat bars 4 in. by $\frac{3}{8}$ in., $3\frac{1}{2}$ in. by $\frac{5}{16}$ in., and 3 in. by $\frac{3}{4}$ in., with cast-iron distance-pieces to obviate buckling, and $\frac{1}{2}$-inch bolts with washers, which are united by a bolt connection to a U-shaped coupling forming a jaw, into which the inclined tie-rods are screwed.

It is very necessary that the lengths of the various elements of a roof truss be accurate, in order to ensure satisfactory results. Hence some means of adjustment are required. The accompanying figure illustrates the lower extremity of the central part of a strut. *C* is the eye connecting the strut with its adjoining elements; and this eye-piece has a thread cut upon it, and is furnished with a nut *b*, by which the length of the strut can be adjusted, so that the central portion of the strut bears upon the nut. But if a tensile strain comes thereon, it is exhibited by the part *a* leaving its bearing upon the nut *b*, which must then be screwed up until the adjustment is effected. Various other means are adopted in different structures, such as coupling nuts with right and left hand screws and other joint connections, capable of taking tension as well as compression.

Fig. 78 gives an outline of a truss in which cast-iron struts were introduced. The roof is 40 ft. $5\frac{1}{2}$ in. span to Type A, having a rise of 10 ft. 10 in. formed of timber rafters 9 in. by 5 in., with $1\frac{1}{4}$-inch diameter tie-rods, covering one of the London and North-Western Railway workshops at Crewe. Fig. 79 shows the form of strut designed to enable the strut and tie-rods to have independent connections.

The roof over the purifying-house of the Sheffield United Gaslight Company, designed by Mr. F. W. Stevenson, is 226 feet in length by 91 feet wide, in two spans, slated upon laths $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $\frac{1}{4}$ in. The roofs are hipped at one end. The merit of the application of Type F is here seen to be advantageous. The ordinary rafters are formed of T-iron 3 in. by 4 in. by $\frac{1}{2}$ in., with T-iron struts 3 in. by 3 in. by $\frac{1}{2}$ in., with inclined tie-rods of $1\frac{3}{4}$ inch and $1\frac{3}{8}$ inch diameter, and horizontal longitudinal tie of $1\frac{1}{4}$ inch diameter at the centre of the lower tie to the principal. The span in the clear of each roof is 45 ft. 2 in., with a rise of 11 ft. 3 in., the tie-rod being raised 18 inches above the springing line. The roof is surmounted by a ventilator of 9 feet span, having timber louvre boards 6 in. by 1 in., fixed as shown in fig. 67; the drainage from the ridge being taken by vertical 2-inch rain-water pipes on to the roof slope.

An example of Type G is seen in the retort-house roof of the East Greenwich works of the South Metropolitan Gas Company; but in this case the tie is not curved, and the truss at the springing is stiffened by the proximity of the first inclined member. The roof is supported by girders; and the principals are placed 6 ft. $7\frac{1}{2}$ in. apart. The span from centre to centre of girders is 72 ft. $5\frac{1}{2}$ in.; and the roof is surmounted with a ventilator 5 ft. 2 in. wide and 4 ft. 8 in. high, open at the top and ends. The rafter consists of two L-irons 6 in. by 3 in. by $\frac{1}{2}$ in., with vertical members $1\frac{1}{2}$ in., 1 in., 1 in., and $\frac{7}{8}$ in. diameter, and inclined members 2 in., $1\frac{3}{4}$ in., and $1\frac{1}{4}$ in. diameter, with a slated slope making 24° with the horizontal. Its length is 427 feet.

Figs. 1 to 21. The roof over the retort-house at Beckton, belonging to the Gaslight and Coke Company, consists of two widths of 120 feet, including a central span of 70 feet and two side spans of 25 feet each. It was designed by Mr. G. C. Trewby to contain 132 settings of inclined retorts each 15 feet long. The ground or coke-hole floor is at the level of Trinity high water, above which the stage for the storage of coal is raised 10 feet. The total height of the retort-house from the ground level to the apex of the roof is 66 ft. 6 in. There are eight lines of railway running through the house—four at the ground-floor level and four on viaducts 30 ft. 5 in. above the ground floor. Three lengths of water-tank 371 ft. 6 in. are placed under the eaves of the roof so as to collect the water from the roof. The side tanks are 7 feet wide, and the central double tank 14 feet wide. The tanks are each 5 ft. $7\frac{1}{4}$ in. deep. At every 28 ft. 6 in. there is a steel roof principal 8 ft. 6 in. deep in the centre, with a curved lower member giving 56 feet clear headway above the coke floor. The straight inclined upper member of the truss, as well as the curved tie, each consists of steel channels $15\frac{3}{4}$ in. by 3 in. by $\frac{9}{16}$ in. There are two secondary rafters of $4\frac{5}{8}$ in. by 3 in. by $\frac{13}{32}$ in. H-steel, spaced 9 ft. 6 in. apart in each bay, supported upon cross girders of lattice work 2 feet deep throughout, having flanges of 6 in. by 4 in. by $\frac{1}{2}$ in. T-steel. The central roof is supported upon steel plate stanchions; and the side inclined rafters form a continuation of the slope at each lower end of the principal. These roofs cover 18 feet out of the 25-feet side spans; the tanks occupying the remainder. The slate purlins are of 3 in. by 3 in. by $\frac{3}{8}$ in. L-iron, spaced $10\frac{1}{2}$ inches apart centre to centre, fastened to the main and intermediate rafter by angle cleats 3 in. by 3 in. by $\frac{3}{8}$ in. The spandril brackets, which rest upon the stanchions, have two $\frac{3}{8}$-inch check-plates riveted with $\frac{3}{4}$-inch rivets, 4 inch pitch, thus forming a closed box support, which is filled with concrete to a depth of 6 feet above the springing level; and the central portions of the main principals, 58 feet span, are attached to the 6-feet spandrils by two angle frames 3 in. by 3 in. by $\frac{1}{2}$ in. An open ventilator 313 ft. 6 in. long, beginning and ending over a principal, runs throughout the roof; and it is 4 feet wide with sides 2 ft. 6 in. high, made of $\frac{3}{16}$-inch plate riveted to vertical T-iron 3 in. by 3 in. by $\frac{1}{2}$ in., 4 ft. 9 in. apart. The details of this roof, as furnished by figs. 1 to 21, show the construction, which was erected by the Horseley Iron-Works, of Tipton, under the superintendence of their representative, Mr. H. L. Batting.

Figs. 58 to 61. Another interesting form of a roof with an arched lower member is given in the design for the new retort-house of the Hartlepool Gas and Water Company, made by Mr. T. Bower. The roof is 100 feet clear span, 230 feet long, and is to be arranged for inclined retorts with overhead coal storage tanks, &c. There are to be ten main

arches, with perforated web plates; the flanges being formed of angle iron and plates. The roof springs at a level of 21 feet above the floor, and has a clear height of 61 feet to the under side of the arch. The stage is only 3 feet above the floor of the coal-store. The straight inclined rafter consists of two L-steel 4 in. by 3 in. by $\frac{3}{8}$ in., carrying duchess slates on 2 in. by 2 in. by $\frac{1}{2}$ in. L-steel purlins $10\frac{1}{2}$ inch centres. Between the sloping rafter and the top of the arch member, struts and ties of $\frac{1}{2}$-inch bars are inserted with packing-pieces and riveted. The curves to the soffit of the arch are 36 ft. 3 in. radius from the springing to a distance of about 34 feet upwards, and thence a curve of 62 feet radius over the centre. The main principals are supported by brick piers 3 ft. 9 in. by 3 ft. $4\frac{1}{2}$ in., built into walls 1 ft. $10\frac{1}{2}$ in. The ventilator is simply an opening of about 5 feet wide carried over the ridge the whole length of the building. The main principals are 21 ft. 6 in. apart, with secondary rafters, consisting of two L-steel 4 in. by 3 in. by $\frac{3}{8}$ in. with trussing of 3 in. by $\frac{3}{8}$ in. bars, dividing the bay into three divisions.

The roof over the Sunderland Railway Station (N.E.R.) is covered somewhat similarly to the above, the principals being 95 feet span with a clear headway in the centre of 45 ft. 6 in. The ridge is here raised about 9 ft. 6 in. above the bottom flange of the arch at the crown, to carry the rafters, which run down upon each side in a straight line to the gutters resting upon the side walls, which are raised at the abutments to receive them. The upper portion of this roof is glazed, and curved glazing is thus avoided. The outside lower portion is slated; while the interior view shows curved boarding carried over the main ribs.

In conclusion, the author has shown upon figs. 74 to 77 a design for a shed 94 ft. 6 in. by 30 ft., covered with corrugated iron, which, though not suitable for covering the roof of a retort-house, can be used to shelter stores. The shed is shown raised 3 feet above the ground level. If used for a coal-store, the raised floor would be omitted. The principals are 13 ft. 6 in. apart, formed of T-iron 3 in. by 3 in. by $\frac{3}{8}$ in., with struts of flat iron $2\frac{1}{2}$ in. by $\frac{5}{16}$ in., and inclined tie-rods $\frac{7}{8}$ in. diameter with lower ties 1 in. by $1\frac{1}{8}$ in. diameter. The principals are 13 ft. 6 in. apart, and have purlins of L-iron $3\frac{1}{2}$ in. by $3\frac{1}{2}$ in. by $\frac{5}{16}$ in., with cleats. The corrugated iron employed is No. 18 B.W.G.; and the building is fitted with sliding doors at the sides.

The author has not attempted to record any particulars of prices, which, at present rates, furnish no guide to actual cost, as it is impossible to prophesy what the prices of the next twelve months may be.

Discussion.

The President observed that the paper was so full of figures and details, that it was more suitable to be read quietly by themselves than before an audience; but it was interesting to observe the various types of roof, showing not only how to do it, but also how not to do it. It struck him that the particular joint which Mr. Walmisley had pointed out was about as bad a type of construction as it was possible to have. It was one that in his own engineering work he would never have used; and it certainly would not be adopted to-day. It was probably one of the old types. He remembered that many years ago, when he first went into his father's office and learned to understand the rules of roof construction, he took it into his head to work out a roof which had just been designed by the draughtsmen, to see if the design were correct. He found it was certainly strong enough, and was not likely to fall in a century; but the strength was entirely misplaced, for what ought to have been the strongest member was the weakest, and though the weakest member was fairly strong enough for the purpose, there was immense waste. The prevention of waste was the real use of understanding how to do these things. As a rule, an Englishman did not make things so weak that they were likely to fall, though now and then they read of an accident of the kind; but they very often put much extra weight, not only into roofs, but into almost every other thing they had to deal with as engineers. To himself, this paper was a very interesting one. He hoped that every gentleman present would criticize it, if he could; and if he could not, praise it.

Mr. C. E. Jones (Leyton) said he felt they were much indebted to Mr. Walmisley for bringing before them different types of roof suitable for all purposes; and they must be very hard indeed to please if they could not find a roof to suit them in the illustrations. He would like to ask if Mr. Walmisley considered it advisable to use cast iron in any roof. For his own part, he thought that cast iron was a source of weakness and danger, which it would be better to eliminate. He endorsed the remarks of Mr. Walmisley with regard to corrugated-iron roofs for gas-works. The life of corrugated-iron roofs was very short; and altogether he thought there was no economy in using them. The same remark, in his opinion, applied to large light roofs that were exposed to much wind. Copper, lead, or zinc nails for fastening would, after a time, wear away and get cut, with the consequence that slates would be stripped off during the next storm. There were various situations in which a very light roof was needed in gas-works; and experience seemed to show that some uniform type of roof principal was required. In roofs, as in many other parts of engineering, it would be as well for them to have a certain type for a certain span; and if it were possible for manufacturers to keep such things in stock, a great deal of trouble would be saved to those who had charge of the erection of works. The paper was one which they could take to their studies and digest with more satisfaction than they could in the course of rapid or hasty discussion in that room. But he would be glad if Mr. Walmisley, in replying, would suggest some types of spans which he thought could not be improved upon with their present knowledge of designing. They were much indebted to Mr. Walmisley for the information he had given them, which was very varied, and certainly most valuable. He thought the Institute should tender to Mr. Walmisley their best thanks for bringing before them such a valuable description of roofs of all kinds.

Mr. F. W. Cross (Lea Bridge) said he was sure the younger generation of gas engineers would appreciate the paper and the various types of roofs illustrated. He would ask Mr. Walmisley to add to the information contained in his paper by giving them some idea of the difference of the strain upon the walls—the outward thrust—of the straight roof and curved roof. What was the difference, if any?

Mr. Fletcher W. Stevenson (London) said it seemed to him rather difficult to discuss this paper, because Mr. Walmisley was a visitor who had been invited by the President and the Council to read his paper. At the same time, members of the Institute must ask him questions; and if they did not quite fall in with what he had said, they were entitled to express their objections. The first point he wished to mention was that the paper did not in any way help them in the matter of the designing of roofs. Mr. Walmisley had givem them examples of what had been done in retort-houses and other places; but Mr. Walmisley was an expert in the matter of roof designing, and personally he would rather have heard from him what faults he could pick in these different designs. He (Mr. Stevenson) had, when applied to, most willingly given the design of the roof over the Grimesthorpe retort-house at Sheffield, because he thought he would hear what were the weak points in it. Was it weak or was it strong, or was the material badly placed? The same with other engineers. They would, he was sure, have been glad to have had from Mr. Walmisley some criticism which would have helped them; and they would have liked to have had instances where designs were faulty on general principles. With respect to the fastenings of slates, Mr. Walmisley had mentioned copper and zinc clips; but his own experience of copper was that it was totally unsuitable for retort-house work, as the fumes carried up by the steam in quenching the coke would destroy any copper fastenings, he should say, in twelve months. On the other hand, good lead would stand for many years in that position; and the plan adopted in Sheffield was to have lead nails about 4 inches long, which were twisted round the slating purlin, and made secure. He thought it well that the slates should be tiered with good hair mortar underneath, in places exposed to high winds, as this prevented them from blowing off. He would like to ask a question with reference to dead-weight. Mr. Walmisley said that "the dead-weight of a structure increases with its span. A weight of 8 cwt. per square is ample to allow for a roof of 60 feet span, or 10 cwt. for a span of 100 feet, if intended to carry slates on boarding." Did this refer to the weight of the framework only, or did it include as well boarding and slating, &c.? As to the use of corrugated-iron roofing for gas-works, it was quite true that it was not

suitable for retort-houses, or for buildings which were much exposed to injurious fumes. But he thought there were many places for which it did very well; and it should not go forth that corrugated iron was not suitable for roofing in gas-works at all. For coal-sheds, for instance, where the trucks were brought in underneath the roof, and coal was likely to strike against the roof, and there would probably be a great deal of vibration, nothing could be better for roofing than corrugated iron. By tarring the roofs, they could be made to last for many years. He knew of examples in Sheffield where roofs had been kept in very good condition indeed by this means; and in respect of its atmosphere, hardly any town could be worse than Sheffield.

Mr. G. R. Hislop (Paisley) said he had found slating a source of very great danger to the lives of his men. At his own works, there had been very many narrow escapes from loss of life and serious injury through the use of slates; and he would certainly say that in any exposed situations galvanized iron was preferable. He had never been, generally speaking, an advocate of galvanized roofing; but of two evils one sometimes chose the least. Notwithstanding the expedient of tying the slates down with bars on the top, and double nailing with zinc nails, there were certain parts where the wind got hold of the slates and lifted them up, like the leaves of a book, to a great height. He had actually seen a "Duchess" slate come down and crack a flag in the pavement below; and when a storm came on, there was nothing for him to do but to dress himself and sit up all night, in the expectation that every minute some accident would occur. Being in this dilemma, in recent roof construction he had had to abandon the idea of slates. Like his friend Mr. Stevenson, he took the precaution of double coating corrugated roofing with good oxide paint, inside and outside, and also occasionally gave it a good finishing coat of slate colour outside, which took away the temporary idea that one generally had in looking at a corrugated-iron roof. So that he thought the advantages of slating did not at all times hold good. But circumstances should be taken into account. This at least was his own experience, where works were seriously exposed to storms. Another idea in connection with roofing was that the roof should have a sufficient margin of strength to enable them to put a batten across two or three of the tie-bars of principals, to elevate retorts and put them into position, or to lift retort-mouthpieces, ascension-pipes, &c., in the retort-house. This he had found to be a great advantage, instead of having to erect temporary apparatus to elevate the retorts. It would necessitate only a very slight additional strength to meet this requirement. It was, in any case, well to be on the safe side as to strength; and a very little additional strength would enable them to utilize the roofing in this way.

Mr. William Carr (Stalybridge) said he would like to express his indebtedness to Mr. Walmisley for his excellent paper, which he thought would be of more value to members of the Institute in time to come for reference than it was for discussion. There was a good deal of matter in it which would be very serviceable to members, and would make a very important addition to their proceedings. Like Mr. Jones, he felt that those of them who wished to get their engineering on the cheap, would have preferred to have had a complete specification of a roof for any particular span, to save them trouble in future; but this would infer that finality had been reached in the matter of roof designing. He did not, however, think that finality had been arrived at. As the President had pointed out, some of the details submitted to-day were already obsolete, and had been superseded by more modern and more excellent appliances. He was obliged to Mr. Stevenson for his contribution to the discussion, because he had himself been thinking of adopting a galvanized-iron roof over a coal-store, and from the remarks of the writer of the paper he had begun to doubt whether it would be wise to do so. But from what he had since heard, he felt reassured; and the galvanized-iron roof would have to go on.

Mr. J. H. Crowther (Wallasey) said, with regard to the general character of Types C and E, he thought it most desirable to put a suspension-rod to keep up the tie-bars in the centre of the roof; a very light bar being all that was necessary. There was nothing said in the paper about wind-ties in connection with the bracing of these roofs. Of course, wind-ties in any building were of service; and he thought it was most desirable to have them in all buildings where there was a long length of roof. Referring to the passage in which the author spoke of the slate purlins being fastened to the main and intermediate rafters by angle cleats, he did not know why cleats were required when they had purlins; but he took it that Mr. Walmisley was not responsible for all the designs of these roofs. With regard to slating, there need be no fear of danger in slating any roof, however exposed. With pure lead nails, it was absolutely necessary that the slate should be tiered on the under side. But it was not much more expensive to put wood purlins and copper nails; and the copper being protected from any fumes they would have a perfectly safe fixing. He did not think this was the best form in which such a paper could have been given. If there had been something more in the nature of working out of details and of the principles of construction, it would have been more beneficial than that they should have before them drawings of a lot of good roofs like these, which might be copied without being understood.

Mr. Hislop remarked that he had omitted to say that, in his opinion, the use of cast iron in roofs was a thing of the past. He did not think that cast iron should be used for roofing of any description. He had had a good deal of experience of the serious consequences and damage arising from the employment of cast-iron struts; and, in his opinion, the use of cast iron ought to be abandoned.

Mr. T. O. Paterson (Birkenhead) said that, upon the question of damage to roofs by storm, he could speak with confidence of the advantage of using 2-inch battens bolted on to the angle irons of the roof; the slates being nailed on with galvanized iron nails. Having adopted this plan for the roof of a large retort-house, and also of a purifying-house, erected for fifteen years, they had never had the slater on the roofs since they had been erected; whereas in the old retort-house, where lead nails were used, there was always expense after the winter gales in getting the roofs done up.

Mr. S. W. Durkin (Southampton) said, with reference to the point of fastening slates on to these iron roofs, some years ago he had a good deal of trouble. He tried copper strips bent round the angle iron; but in process of time they disappeared, and the slates began to disappear as well. He also tried fixing them with slips of Muntz's metal used for sheathing wooden ships, and found them more durable than copper. He had adopted somewhat the same system that Mr. Paterson described, of wooden laths bolted to the principals, and placed in front of the angle iron laths, and using yellow metal counter-sunk nails. They were a little more expensive; but they were far and away better than galvanized iron, and their durability was very great indeed. With regard to galvanized-iron roofing, he had had some experience of covering an open coal-shed with it in a very exposed position alongside of a river; and in their humid atmosphere such a position was a very trying one. The roof had been up now for some years, and had never cost a penny except for a coat of paint on the outside, just to make it look decent and tidy.

Mr. C. S. Ellery (Bath) said one point had been left out of the discussion. He was himself interested in the subject just at present, as he was engaged in taking down a number of roofs erected long since; and he had been struck with the way in which they had kept in position—especially the joints and the parts where one would have expected the strain to be greatest. It was simply a marvel that they should have remained in their place. Two lessons had been taught—namely that, in constructing roofs and working out the weights and strains, they must not draw the matter too fine, as waste was constantly going on, in spite of every care in painting and scraping. He thought that, in designing roofs, the question of accessibility should be kept well in mind. He was disappointed that Mr. Walmisley had not favoured them with any criticisms. It seemed to him that one point to be kept clearly in view, judging from the appearance of the roofs in question, was that the less members there were in a roof the better. It would be advisable to put in a little more weight, and make the members stronger, rather than multiply the members and the joints at which corrosion and rust took place. He hoped to hear something from Mr. Walmisley with regard to securing roofs in position. He was at present putting up a series of roofs and girders; and he had to consider the question as to what extent they should be bolted. He had carefully watched the action of roofs in respect to expansion and contraction, which he

thought was a very important matter; and he had to consider how far they could really tie up the roofs to the walls and girders, and how far they should give them play. They were deeply indebted to Mr. Walmisley for bringing this matter forward; and, as a parting suggestion, he would point out that care should be taken to paint the roofs periodically, and that trustworthy men were employed for the purpose.

Mr. Arthur Valon (Ramsgate) remarked that he would like to say, as one of the younger members of the Institute, that he thought the paper a very interesting one, and one that would be very useful to the junior members of the Society. It had been said that the diagrams were a collection of examples which had not been criticized; but it was just such a collection of examples that the younger members wanted. It was no use for them to work out the stresses. Anybody could do that, as it was really only mechanical work; but they wanted a collection of examples from which they could, by comparison, get the best form of joints and members, and select those which they considered the most suitable. With regard to Type A, he was rather surprised to find Mr. Walmisley saying that it was serviceable either for large or small spans. He had used it considerably for small spans, but found that its economical limit was very quickly reached. He was not now speaking of the truss when loaded at the joints, but when the loading was, as was usual with the retort-house roof, by means of angle-iron purlins; the slating being fastened directly to them.

Mr. Walmisley, in reply, thanked the members for the kind way in which they had received his paper. As to the statement that he had said nothing about wind-ties in roofs, of course wind-ties on a roof were of the highest importance, as it was the question of the wind that mainly affected the decision whether the framework should be fixed (1) on both sides, (2) left free on both sides, or (3) fixed only on one side. The reason he had not touched upon the question in his paper, was one that would be evident to the older members of the Institute, who would remember that he had tried to exhaust the subject in the year 1891; and therefore he could now only refer them to that paper, which really ought to be read side by side with the present one to make the matter complete. There, also, he pointed out that if roofs were as a rule put in a sheltered position, this also affected the question of the walls. With regard to cast-iron members in a roof, certainly, having regard to the sections that they could now obtain in steel as well as in wrought iron, and to what they knew of strains in structures and wind pressures, cast iron should not be introduced for any member that was likely to be subjected to tensile strain. Cast iron was all very well in certain places; and it or cast steel was the proper material for gutters, and also for base-plates, but not for struts or for any member that was at all likely, though generally in compression, to come into tensile strain. They knew that, when the wind pressure was on one side, certain parts of the roof were subject to compression, but that at another time, when the wind varied, they might come partly into tension; and this fact had to be borne in mind. With regard to the question of the connection of the slates to the roof, he had listened with great interest to those who had had experience in the matter. He thought the statements brought forward as to the use of copper were certainly right; but with regard to lead strips, he believed that the question of their deterioration was mainly one of drainage. If water was allowed to hang about a lead connection, some electrical action might take place between the lead and the iron—as they knew it did—and the metals would wear away. To see this, they had only to look at old iron railings which had been fastened with leaden splits. Where the rain water had worked its way in, these railings had got as thin as a cord or thread. But if the roof was so thoroughly drained that water could not lodge near the lead connection, he thought there was nothing to be feared. As regarded the dead-weight mentioned in the paper, this was simply the framework, and did not include the covering. As to the suggestion that, in dealing with these roofs, he should have pointed out where there might be excess of metal, he must admit that he had not calculated the strains in all the roofs. But if he had criticized them and pointed out in some cases that the trusses were too strong, he would probably have been met, in the course of the discussion, with the remark that had been made by one of the gentlemen, to the effect that roofs should be strong enough to carry arrangements for shifting retorts, and they should therefore be made extra strong. The strength of any roof depended so much upon the data and the requirements, and the situation, that he thought, generally speaking, it did not do to cut down the section too fine. They must allow an ample margin for safety; and he certainly thought it was a good plan to allow an excess of metal for deterioration, and also for any unforeseen treatment—such as the shifting of machinery below of perhaps greater weight than the designer might have allowed under existing circumstances at the outset, and in this way bringing undue strains upon the roof. Of course, engineers in charge of retort-houses, when arrangements were made for shifting the plant below, would take care that no cross-strain was brought to bear upon the centre of a long tie-rod. All rods and wires for shifting should, of course, be brought to bear at points where the struts were connected to the tie-rods, and not at the centre of a long tie-rod, where they would cause a deflection which the tie-rods were never calculated to sustain. As to the use of galvanized iron, this was, naturally, a matter of opinion. Except in situations close to the sea, engineers did not care for galvanized iron; and he would far sooner take corrugated iron, and give it two coats of good oxide paint. In some works he was connected with, about ten years ago he put up a sheet of corrugated iron 70 feet by 30 feet; and he would not have it galvanized under any circumstances, but had it covered with two coats of good oxide paint. It was painted every three years, and was as good now as when it was put up. A good designer always took care that every part of a structure should be accessible to the painter's brush; and this he thought was a maxim they would all agree with. With regard to the remark made as to the use of cleats, a reference to fig. 13 would explain this. In the hurry of writing out, he had put the angle in the ordinary way, whereas in the revised proof it would appear the other way up; and in this position a cleat was needed to connect it to the rafter. If the angle was turned round in the ordinary way, he could well understand that the gentleman who spoke would wonder what was the use of a cleat. With regard to his statement that Type A was suitable for large spans, he did not, of course, mean Type A as it was shown in the diagram, but a type in which the bracing members radiated from a point. In that sense, Type A could be used either for large or small spans, if the upper rafter was made sufficiently strong to carry between the unsupported parts. With the upper rafter of proper shape, Type A could be very well adapted for a large span, as they might see at Bristol, where the upper rafter was curved. The remark by one speaker as to reducing the parts and the number of members, so as to avoid a quantity of connecting parts, would also support the argument that Type A might be used for a large span. With a span of 100 feet, Type A would not be suitable, with simply a T-section rafter iron roof. The rafter must be sufficiently deep where it had to be carried on the unsupported parts. Just what was necessary would have to be worked out and tried. There would be more work in that case to be done in the shops. It was, of course, a matter of experiment; and the thing to do was to work out two or three designs, and see which was best. As to Type F, he would have no hesitation in using it for spans up to 60 or 70 feet. Arched roofs were, of course, suitable for larger spans, where the arch rib was made of a good depth. But it must not be supposed that, even with the adoption of a semicircle, outside thrust could be entirely avoided. They all knew the case of the Crystal Palace, at Sydenham. The roof there was constructed in the days when it was believed that wind pressure acted vertically. They now knew that snow acted vertically, but not wind pressure. It was thought that, by making the rib of the arch of the Crystal Palace roof sufficiently deep to act as a girder, the structure would be made perfectly stable. But when the roof was put up, it was found that there was lateral wind pressure, which produced a side thrust; and those very awkward diagonal ties under the gallery had to be inserted for the stability of the structure.

SOME DISPUTED POINTS AMONG GAS AND WATER EXPERTS.

By John Wilkinson, of Drighlington.

At the last November meeting of the Manchester District Institution of Gas Engineers an excellent paper was given

by Mr. Thomas Newbigging, of Manchester, entitled "Some Disputed Points in Gas and Water Works Legislation;" and during a recent perusal of Mr. Newbigging's contribution, I formed the opinion that the matter could perhaps be carried a little further. Hence the subject before you to-day. I trust that no words contained in this paper, will be construed into an attack upon the experts in person; for I am confident that any such attack would meet with the contempt it deserved. I venture to think, however, that there is wide room for a discussion upon the policy adopted by experts when giving evidence.

Opinions or evidence given by gas and water experts may be classified into three divisions—viz.: (1) Evidence in connection with the rating of gas and water works. (2) Evidence on Parliamentary Bills promoted for extended powers. (3) Parliamentary, together with arbitration evidence, for the transfer of gas and water undertakings to local authorities. I propose to leave the question of rating to someone competent to deal with such a puzzling problem. I will only say that, although some differences in opinion do exist, there is a fairly general feeling among the leading experts, that gas and water works are more heavily assessed than are other industrial undertakings in their respective townships.

Commencing my paper then with Parliamentary Bills for extended powers, the most frequent case is that of a gas company asking, among other details, for an increase of capital, together with the sliding-scale; and, as the applications to Parliament by a gas company are few and far between, the local authority naturally takes advantage of the opportunity and endeavours to extract some favour from the company.

The company consider their position; and, with the assistance of an expert, decide upon the proposed increase of capital and the standard price. But directly this is done, objections are put forward by the local authority that the increase of capital is excessive, and will prevent the gas undertaking from becoming municipal property for an indefinite period, and therefore the shareholders are to be enriched at the expense of the public. The standard price being too high, will cause serious loss to the tradesmen, who will not be able to compete with the tradesmen of any neighbouring town, where gas may happen to be a few pence per 1000 cubic feet cheaper. The local authority may probably ask for a purchase clause to be inserted; and, ultimately, the Bill comes before Parliament as an opposed measure. It is then most interesting to hear the expert evidence given for both parties; and as these experts are gentlemen who have had long experience in the profession, it would be absurd to suggest that any one of them was tampering with business he did not understand. It is, however, impossible to account for the wide difference in their opinions with any degree of satisfaction.

The company's experts prove, by figures, that their requests are most reasonable, and they cannot carry out their obligations on anything less. The local authority's experts stoutly deny this—producing figures and statistics to bear out their contention that the capital asked for is fully 100 per cent. too much. They declare that the standard price is anywhere about 1s. per 1000 cubic feet too high, and that the present is a most opportune time for the undertaking to be transferred to them—they being fully convinced that such transfer would be to the interests of both shareholders and public. There is, finally, such a juggling of figures and facts that the majority of Parliamentary Committees must really feel bewildered by them. It would appear, however, that some Committee created the happy precedent of splitting the difference, and the matter is thus settled; but not before some £2000 of provincial gold has found its way to Westminster, in order to pay for the luxury of a parliamentary fight. And I venture to suggest that the £2000 has left the district without either the gas consumers or inhabitants deriving any benefit whatever, owing to the fact that, in all probability, the gas company's experts would have advised them to accept similar terms to what the Parliamentary Committee had granted; but, knowing full well the procedure adopted by experts engaged for local authorities, they were bound to protect themselves by asking for a good deal more than they desired or expected.

If we now take parliamentary and arbitration evidence for the transfer of gas and water works, we again find ridiculous and outrageous differences of opinion. Whenever a local authority desires to compulsorily expropriate a gas company, against whom there have been no complaints—and it would be unique to hear of a gas company without—a great deal is made of the question of precedents. The company's experts vow they are not aware of any case of compulsory expropriation; while the local authority's experts quote, with confidence, a dozen cases—even though a few days before they appeared as company experts, when cases of compulsory expropriation were conspicuous by their absence. It is also probable that the gas company's experts have before appeared for the local authority, when, in accordance with tradition, they were quite prepared to quote cases of so-called compulsory expropriation. There is also the question as to whether or not the company are willing sellers. The slightest slip of tongue or pen by any representative of the company is construed into an offer to negotiate; and only by the gross discourtesy of refusing to acknowledge a local authority's communications can any company face Parliament feeling sure they have not, in any way, committed themselves as being willing to sell.

The amount due for compulsory purchase under the Land Clauses Act may be stated at 10 per cent. in one case, but in another case, a few days later, it has suddenly dropped in the same expert's opinion to 5 per cent., or probably it may have vanished altogether, according to the side he represents.

The number of years' purchase of the maintainable profits varies in the same manner; and 23 years' purchase may be fought for, against a claim for 33 years. In a recent case, the local authority's expert complained very bitterly that the gas company were being awarded 41 years' purchase, against his most liberal allowance of 25 years. This same expert was eventually badgered by Counsel into admitting that, in the case of a small neighbouring company, he had stated, in evidence, that 33 years' purchase was but a fair, and not a liberal, allowance. The question of statutory and non-statutory companies is just as hopelessly confusing; and they are appreciated and depreciated in order to show whatever fictitious value is desired. Prospective value for unexpended capital, together with surplus plant, is dealt with in like manner; and the experts seem to possess the power to command it to appear or disappear at will.

There is then the experts' analysis of the accounts and works, &c.; and such differences in opinion as the following are quite common:—

Gas made per ton of coal,	9000 cubic feet,	against	10,000 cubic feet.
Tar made per ton of coal,	9 gallons	,,	12 gallons.
Sulphate of ammonia made per ton of coal,	20 lbs.	,,	30 lbs.
Lost gas (leakage),	5 per cent.	,,	10 per cent.
Value of lost gas,	selling price	,,	cost of production.
Repairs of works, mains, meters, &c.,	5d. per 1000 cubic feet of gas made	,,	9d. per 1000 cubic feet of gas made.
Maintainable profit,	£1,044	,,	£1,626.
Surplus works,	£3,580	,,	minus £300.
Total value of works,	£55,360	,,	£22,911.
Capacity of carbonizing plant,	50 per cent. excess	,,	50 per cent. deficient.
Capacity of condensers,	ample	,,	25 per cent. deficient.
Capacity of scrubbers,	considerably in excess	,,	just sufficient.
Capacity of exhausting machinery,	very ample	,,	50 per cent deficient.
Capacity of purifiers,	considerably in excess	,,	13 per cent. excess.
Capacity of station meter,	100 per cent. in excess	,,	just sufficient.
Capacity of storage,	very ample	,,	12 per cent. deficient.
Capacity of mains,	100 per cent. in excess	,,	just sufficient.

The above are not imaginary or hearsay, but are statements which have actually been given as evidence by experts engaged in recent cases. It would involve too much time to go through the items separately; and I will only point out the absurdity of any expert calculating the value of lost gas at the selling price to the consumer.

I now come to the real point of this paper—that is a desire to elicit the opinions of the experienced members of this Institute as to whether or not they consider as satisfactory the present basis on which experts are compelled to give their evidence. Whenever resource is made to Parliament or arbitration, do experts give their evidence on the basis of justice and equity to all parties concerned? And, if justice and equity are the basis of those inquiries, why is it that gas and water companies show such a fear and dread of appearing before a Parliamentary Committee or a Court of Arbitration—why do they sacrifice some of

their rights and privileges in order to clear away any threatened opposition? I am firmly convinced that the whole system needs quick and drastic reformation. I consider as unhealthy any basis or system which compels an expert to walk round the boundary walls of a gas-works, and then go to Parliament and give evidence that the works are old and antiquated, and not able to meet the consumers' demands for gas. Any principle must be wrong which demands an expert to say that a gas company selling gas at 2s. 6d. per 1000 cubic feet is badly managed, when, but a few days before, he spoke most favourably of a similar company who were charging 4s. per 1000 cubic feet. Quite recently, suggestions were made by experts that the most important gas companies of this country were guilty of doctoring their gas at the testing-stations—one expert vowing that, with a certain form of photometer, he could always get a reliable test of so many candles; while the experts on the other side were prepared to prove that they could not get within a difference of 2 to 6 candles.

My contention is further strengthened by certain remarks which have recently been made by eminent gentlemen connected with the gas and water profession. For instance, only a few weeks ago the attempts made by a leading gas expert to appear consistent were characterized by a well-known Queen's Counsel as damnable heresies. Again, the chairman of a large gas company (himself an expert), speaking of arbitration, said: "We know perfectly well—better than any arbitrator—what the concern is worth to us; and we will trust no arbitrator whatever. He would be misled probably by the *evidence* and by the specious talk of the lawyers." I well remember the following expression of an eminent Baronet, who enjoys a large practice as an expert: "I never see that light burning at the House of Parliament without wondering what person's property was being confiscated, and whose rights and privileges were being violated." If these are the feelings of the leading lights of our profession, do they not suggest that something might be attempted to place negotiations relating to our business on a firmer and more honourable basis.

The chief gas experts are gentlemen who have occupied the chair of this Institute. They are well known to each other; and what is there to prevent them from meeting together and fixing standard facts and precedents, and firmly adhering to them, no matter what side they represent. If this could be done, the experts would gain the confidence of all parties responsible for the management of gas undertakings. Their advice would, therefore, be more frequently sought than at present, for the feeling of mistrust would diminish. They would thus be enabled to command increased fees (for large sums of money would be saved every year which are at present thrown away in useless litigation); and general advantage would result to shareholders, consumers, and the general public. The gas industry is honest and straightforward; sharp practice and trade secrets are almost unknown. Any expert can quickly sum up the value of an undertaking from a balance-sheet and a knowledge of local circumstances. He knows perfectly well what can be got and done with the products from a ton of coal from any of the coalfields.

There is another matter which I have never heard discussed; and, although it may not appear to come within the title of this paper, I propose to mention it in the hope of hearing some expressions of opinion thereon. I refer to the question of costs in parliamentary proceedings. It seems to be the general rule that both parties must pay their own costs; and I understand no deviation is ever made from this rule, unless every member of a Committee is present and unanimous in opinion. In ordinary law, costs usually follow the verdict; and it would be interesting to hear a full explanation of the reason why Parliament makes the distinction. Cases are known where small companies have been put to great expense by being compelled to oppose repeated attempts to interfere with their rights; and, to say the least, the rule of Parliament would appear to offer temptation for wealthy bodies to persecute their humbler friends by repeated applications to Parliament.

In conclusion, I must apologize, for bringing so crude a paper before you; but after committing myself to its preparation, I found it was almost impossible to treat the subject fully without mentioning names of towns and persons, to which I have a strong objection. Moreover, I was reminded of the fact that our worthy President was himself an expert; and I had thus unwittingly strayed into the "Lion's Den."

Discussion.

The PRESIDENT observed that, whether the paper contained any straight-told truth or not, it had certainly been a very interesting one. It had been excessively interesting to himself; but he must say that Mr. Wilkinson did not understand the methods of local authorities and public companies, because experts found that if they tried to save them money, and gave them good advice, they did not increase their fees at all, but did just the other thing. In these circumstances, the experts were not offered any inducement to bring about settlements. At the same time, he always tried to make his people agree if possible, because he could easily get better terms for them by so doing than by fighting. When the blood got heated, people were apt to say at the end: "We won't give anything unless Parliament does it;" and Parliament or the Parliamentary Committees were accused of having invented the process of division. But he himself had always thought that this process was very much older, and that it was invented by one of the most learned and clever men of whom we ever read, when he ordered the poor baby to be cut in half. It was since then that they had heard of splitting the difference. He did not think that the poor experts were so bad as they were painted. Their clients came to them, and asked for their advice as to the best way of putting their case before the Court or tribunal; and would it be honest of the experts to show the other side how to present their case? The experts could not tell everything. They could not tell the other people how to fight their case. But he had often wished that he could fight on both sides, as he felt that he could conduct the matter much better than the others did. If in one case the experts were for the local authority, and in the next case for the gas company, were they any worse, so long as they told the truth, than the barrister who represented his clients, or the solicitor who acted for them? Then, again, as to arbitrations, whereas one company might be worth 33 years' purchase, another company might not be worth more than 23 years. This depended on position, and the circumstances of the case; and just in the same way one house or a parcel of land might be worth 30 years' purchase, while another house or another parcel of land might not be worth nearly as much, because it was not in so good a position and did not appreciate so much, or it might be that it depreciated. All these things had to be taken into consideration. Although Mr. Wilkinson had not mentioned the names of any experts, he had rather dotted the i's and crossed the t's for those who knew in which direction to look; and in some of Mr. Wilkinson's remarks he could recognize several of his own friends, who were near and dear to him. At the same time, he was exceedingly pleased that the paper should have been read. It was an amusing paper, as well as an interesting one; but he did not know that it would have any good effect unless Mr. Wilkinson could induce employers to treat experts in a fair and proper way when, by settling cases, they saved the enormous expenses of which Mr. Wilkinson complained.

Mr. W. A. VALON, having been called upon by the President, said it had not been his intention to enter into the discussion on the paper; and he would say what he had to say in as few words as possible. The President had said that some of Mr. Wilkinson's remarks, he thought, applied to persons whom he knew. Personally, he did not recognize them. The paper was no doubt honestly written from the point of view of the writer; but from his (Mr. Valon's) point of view, the conclusions he arrived at were erroneous from beginning to end. If the suggestions made in the paper were followed, there would be no need either for a Court of Appeal, a Judge, or a Jury. A statement, when made by an expert, should, according to the writer, be able to be accepted on both sides as correct without question, and should not require to be subjected to the usual laws of evidence, to see how far prejudice, feeling, and circumstances ought to modify the statement. An expert giving evidence for purchase would doubtless come to the conclusion, after having given attention to all the circumstances surrounding the case, that in some instances a property might be worth 30 years' purchase, and in another 25 years or less; and both assertions would be absolutely true, though from an outside point of view the difference might appear irreconcilable. In the valuation of gas-works, there were no two concerns in the country where the

valuation could be exactly the same, unless they were entirely on all-fours the one with the other. But this was not possible. Most of the gentlemen he was addressing were conversant with gas-works situated in different parts of the country. Did they know of any two where the conditions were absolutely the same? He could not call to mind any cases perfectly parallel. There were, of course, instances which were almost parallel; and in those cases the rating should be nearly equal. Take the London Companies. Here, at least, it might be thought that the rating of the one Company should govern the rating of the other; but this was far from being the fact. The cases were not parallel. There, as elsewhere, in making a valuation, the capital expended, the working expenses, the price of coal, the receipts for residuals, and the ultimate profits derived from manufacture, all had to come into account, which in no two works were alike. Hence, from an outsider's point of view, the valuations were inequitable. Of course, it must follow that, where hypothetical claims were made on one side which were not taken into consideration on the other, there would be always a wide difference in the result arrived at; but he thought, after the claims had been laid before, and sifted by, the best tribunal the country afforded for the purpose, and a decision arrived at by that tribunal, it was not possible for an outsider to complain that, because the decision in one case appeared to him different from that in another, therefore the decisions were wrong. Nothing was more misleading than an attempt at comparison of cases. Each matter—either valuation or purchase—was a new subject, and must be examined independently of anything that had gone before. He was quite certain, however, leaving himself out of the question, that as a rule expert witnesses deserved the credit of giving the best advice at their disposal, of fighting the cases entrusted to them upon as good a ground as they could select, and generally of doing what was possible to be done in the interests of their clients.

Mr. J. P. Leather (Burnley) said he thought that Mr. Wilkinson's conclusions were certainly wrong, while at the same time there was a good deal of truth underlying the paper. Mr. Valon had indicated some amount of error in comparing the number of years' purchase as between one company and another; but the point which he thought really troubled Mr. Wilkinson was that two experts, both considering the same company, and both having a very good knowledge of the circumstances, did not come to anything like agreement. That was really where the difficulty was in understanding this question of expert evidence. The remedy, if there was one at all, was certainly not in the direction which Mr. Wilkinson had stated; for the simple reason, as the President had pointed out, that it was impossible to say that a certain rule or a certain figure applicable to one case was applicable to another. The only way he saw of remedying the evil—and he did not know whether it was practicable—was in the direction of the tribunal. Instead of cases of this kind being fought by two sides, each having their own expert witnesses, the tribunal should call as witnesses experts not in the pay of either side, but who should be as far as possible impartial. Under these circumstances, there would not be anything like as much difference between the experts. There were several practical difficulties in the way of this suggestion; but nevertheless it was, he thought, the one that was most workable. One of the difficulties was that the engineers, and those who could really speak best, were to some extent connected with the companies they represented, or even if they were not taking fees from a company in a particular case, they might be wishing to have business relations with the undertaking. Things of this kind interfered with the getting of absolutely impartial evidence; but he did not think there was any better way of bringing experts' opinions into more immediate relationship than by making the experts altogether independent of the two sides to the controversy.

Mr. H. Lees (Hexham) wanted to know whether the writer of the paper was serious or not. He supposed they should assume that he was. In the earlier part of the paper, Mr. Wilkinson said he proposed to leave the question of rating to some one competent to deal with such a puzzling problem; and having passed that over thus lightly, he went on to deal very thoroughly, from his point of view, with the still more important question of the purchase of gas undertakings and appearances before Parliamentary Committees. Now he should have thought that one who could deal with so much confidence with the larger question, would not have left the smaller one in that way. The subject of rating was an important one, and it was one that they had to deal with more frequently than they had with the larger question. However, Mr. Wilkinson said he had left that to others; and unless he dealt with it in his reply, he supposed they must leave it, and be thrown back upon the experts. Although he did not hold a brief for the experts, he did not think Mr. Wilkinson was quite fair to them. There were, of course, two sides to the question. In the first place, Mr. Wilkinson said the balance-sheet was so plain that it was not possible for two people to have different opinions as to what were maintainable profits. But he (Mr. Lees) contended that in any balance-sheet that might be presented, experts representing different sides would find points of variation; so that the value of works could not be agreed upon. Then came the contention. Having fixed the maintainable annual profit, it was not always so easy to get at the number of years' purchase as would appear by the references to the subject which had been made in the paper. There, again, there were points of difference—local circumstances, from which different deductions might be made by different people—and, therefore, they were once more thrown back on the work of the experts. He had reason to believe, and no doubt most of them believed, that the experts did the best they could for their employers. But why should gas and water companies dread appearance before a Parliamentary Committee? He knew of no reason, if such companies had a good record; but if there was something in their history which might be brought forward by the experts and the lawyers on the other side, they might have a reason for not wishing to appear before Committees, and might be wise in sacrificing something of what they called their rights and privileges rather than face the ordeal. He thought this might be the explanation in many cases; but where gas and water companies had a good record, they had nothing to fear.

Alderman Miles (Bolton) drew attention to the table in the paper, which Mr. Wilkinson had carefully avoided reading, and said he thought Mr. Wilkinson should explain to the satisfaction of the members how it was that under any circumstances he had arrived at some of the deductions therein contained. He presumed that Mr. Wilkinson had given them the table as being the results of the evidence of two experts, one for and the other against, in the case of a single gas-works; one expert saying that the capacity of the carbonizing plant was 50 per cent. in excess, while another said that it was 50 per cent. deficient. How such statements as these could have been made by two experts who considered themselves honourable men, was more than he could understand. It seemed to him that they were deliberate misstatements, if they were ever made at all; and he wished Mr. Wilkinson to tell them whether they were real records of facts. Again, one expert said the capacity of the exhausting machinery was very ample; while the expert on the other side said it was 50 per cent. deficient. The same applied to the capacity of the mains; one expert saying that it was 100 per cent. in excess, and the other that it was only just sufficient. Having had something to do with experts on Parliamentary Committees, he felt bound to say that within his small experience he had never found gentlemen varying to such an enormous extent; and he would like Mr. Wilkinson to give them some proof of the accuracy of his statements.

Mr. R. G. Shadbolt (Grantham) thought that Mr. Wilkinson was to be congratulated on the courage he had displayed in bringing forward his paper, and also upon his discretion in leaving the assessment question severely alone. He presumed that these differences of opinion would arise so long as time existed; and, indeed, if it were not for them, the calling of the experts would be gone. Circumstances were so various, that it was impossible for two experts to arrive at exactly the same conclusion. The great divergences of opinion which existed in many cases were, he thought, to be accounted for by the point of view taken by the respective experts—no doubt conscientiously. One point he would like to touch upon was as to the costs in which the companies were mulcted from time to time. This was a matter which was well worth bringing out. It did seem a hardship that two concerns, one provided with large means and the other with small, should be mulcted in costs to an equal extent; and if some arrangement could be arrived at by which the loser of the case—assuming it

to be the larger undertaking—should bear part of these costs, it would not be such a hardship. There was no wonder that small undertakings contemplated going for further powers with a great amount of dread, having in view the possibility that, after severe cross-examination and riddling, they might find themselves burdened with overwhelmingly heavy costs; and he considered this was a point which the writer had done well to bring forward.

Mr. W. R. CHESTER (Nottingham) thought that one reason why Mr. Wilkinson had arrived at such extraordinary conclusions was that he had not followed the cases sufficiently closely to discover the explanations which came out in cross-examination. Otherwise he would have seen that it was perfectly understandable how there might be a difference of 50 per cent. excess and 50 per cent. deficiency. In some of the figures which Mr. Wilkinson had quoted, he thought he could identify the individuality of certain gentlemen; and when he perceived how the difference was arrived at, he said, and he thought they would all agree, that there was a reasonable cause for the difference. Take, for instance, the exhauster plant to which Alderman Miles had just referred, and which one expert declared to be ample and the other expert stated to be 50 per cent. deficient. In that particular case, which he could identify, the difference was as between a single exhauster and a duplicate exhauster. A great many of them would like to have a duplicate exhauster, but were forced to carry on their work with one; and the difference (which looked absurd at first sight) was merely one of opinion as to whether a duplicate exhauster was or was not an absolute necessity. In purchasing works, they would give more for those which had a duplicate exhauster than for those which had only one which was being worked to its full capacity. He fancied Mr. Wilkinson must have mixed up a number of different cases, because as a rule, in an arbitration, an accountant was appointed to take out the figures as they actually stood; and there could be no disagreement as regarded facts. If 9000 cubic feet had been produced at a gas-works, he was sure that there was no expert who would come forward and say that an imaginary 10,000 cubic feet had been produced. The same with regard to the number of gallons of tar. No expert would say that the tar produced per ton was 9 gallons, if it was actually 12 gallons, or that the amount of sulphate of ammonia produced per ton was 20 lbs., when the actual figure was 30 lbs. These were facts that could be verified from the accounts of the company, and admitted practically of no variation. It was not perhaps such an easy matter to arrive at the difference in apparatus. For instance, one individual might think the capacity of the purifiers, taking a certain basis and a certain kind of coal, was sufficient for the purpose; while another expert would deal with the purifiers on the basis of another kind of coal. Hence they got such a difference as was represented in the table by "considerably in excess," and "13 per cent. in excess." One expert perhaps knowing more accurately than the other the kind of coals used, it might be that the figure of 13 per cent. was the more accurate of the two. This was a subject which might be made to afford a great deal of amusement at the expense of the experts; but he thought Mr. Wilkinson's attitude arose from not following the facts of the case right through from beginning to end, and from his detaching a portion of the facts from their context. When Mr. Wilkinson had had more experience in the transfer of gas-works and of parliamentary proceedings, he would no doubt not be inclined to write an amusing but inaccurate paper such as this.

Mr. WILKINSON, in reply, said that the gentlemen who had taken part in the discussion might be classified in two divisions—experts and non-experts. He would reply to the experts first of all. The President, Mr. Valon, and Mr. Chester had all taken exception to the figures; but he noticed that, though they went into figures with regard to the plant, they had carefully left alone the £ *s. d.*

Mr. VALON wished to say that he had gone into no figures at all.

The PRESIDENT said neither had he. He had simply dealt with the number of years' purchase.

Mr. WILKINSON observed that none of the speakers had been able to explain why one expert in a case should say that a concern was worth £55,000, while the expert on the other side in the self-same case should say that the undertaking was only worth £22,000. There was a most serious difference there; and it represented somebody's money. Whatever had been said, nothing had been put forward as to how these differences in opinion did arise. No doubt experts gave their evidence honestly, under the circumstances in which they were compelled to give it at present. The expert said to himself: "I must do my best for my client," and that was perfectly right. But, in his opinion, it was possible for experts to formulate a better way of arriving at a reasonable decision. In the case in point, the difference was practically split by the arbitrator; but it was simply ridiculous that in such a valuation experts should differ in opinion to the extent of something like £30,000. In reply to the question whether all these instances related to one and the same case, he would say that the differences were the differences of two or more experts engaged in the same case—that was to say, one gentleman said the value of the works was £55,000, while the other said it was only £22,900. It was the same throughout with all the plant.

Mr. CHESTER remarked that the figures in the table must apply to more than one case, as there was no single instance which would embrace them all.

Mr. WILKINSON said he had not taken one expert's opinion as to the exhausting power, and then gone to another works and taken his opinion there.

Mr. CHESTER said the figures must have been detached, as there was no cohesion between them.

Mr. WILKINSON observed, with reference to the remarks of Mr. Leather, that he did not know whether or not the tribunal could be improved. As to the accuracy of the balance-sheet, he agreed that it was quite possible for some small error to creep in; but it should not admit of a difference of opinion to the extent of 75 per cent.

The PRESIDENT said he would like to make one correction of the paper. He knew where these figures had been obtained from exactly; and he thought others did, too. The comparison of 5d. per 1000 cubic feet of gas made for repairs with 9d. was an error. The two experts agreed upon the figure of 5d.; but one of the Counsel threw over his own witness, and claimed 9d.

Mr. CHESTER: And said that consistency was "a damnable heresy."

Mr. WILKINSON remarked that the President was on the wrong case altogether.

NAPHTHALENE FROM RETORT TO POINT OF DEPOSITION.

By WILLIAM YOUNG, of Peebles.

The reason why naphthalene gives such a large amount of trouble and annoyance during the manufacture and distribution of gas is that, as you are aware, at all ordinary temperatures it passes directly from the state of vapour diffused through the gas to that of a crystalline solid. It does this just in the same way that water vapour diffused through gas or air is deposited as crystalline ice or hoar frost, at all temperatures below the freezing point of water.

The difficulties which arise from the deposition of naphthalene are further accentuated by the naphthalene being deposited in fine thin laminated or feathery crystals. This form of deposit enables a very small weight of naphthalene to occupy a large space; and further, in consequence of their lightness, when these feathery crystals do not become fixed to the walls of the large mains and vessels, they are liable to be drifted or blown forward in the current of moving gas until they become entangled in the narrower passages of the service-pipes.

While these properties of the naphthalene are well known as explaining the nature of naphthalene troubles, it is not so well known and recognized that the same cause—the direct assumption of the crystalline form from the vapour, and *vice versâ*—to a very considerable extent accounts for the naphthalene vapour being present in the gas, so as to produce the trouble referred to.

To get a clear conception of how such results are brought about, it is necessary briefly to consider certain conditions which prevail, and some of the physical and chemical forces brought into play during the processes of condensation, purification, storage, and distribution.

One ton of ordinary gas coal, when carbonized at the high temperatures employed in modern gas-works, will produce approximately from 10,000 to 11,000 cubic feet of permanent gas, accompanied by from 120 to 130 lbs. of condensable hydrocarbon vapours, together with variable quantities of water vapour, ammonia, &c. These products

leave the retort and enter the stand-pipes accompanied by a considerable quantity of flocculent carbon.

The Opposing Forces During Condensation.—The separation and allocation of these products, between the gas and the tars, commence immediately on the products of distillation leaving the retorts. The forces which come into play so as to effect the separation are those of the respective vapour-tensions, the mutual solubilities, chemical affinities, &c.

The hydrocarbon vapours are all more or less soluble in the liquids which result from condensation, just as the ammonia is highly soluble in the condensed water vapour. The great bulk of the hydrocarbons produced have so low a vapour-tension that they cannot remain in the gas in a state of diffusion, but are precipitated as liquids; and these liquids, carrying down with them the flocculent carbon which accompanies the products of distillation, appear as liquid tars. These liquid tars, having a large solvent affinity for the other and smaller portions of such hydrocarbon vapours as have higher vapour-tensions, tend to take them up in solution and to absorb them out of the gas. But these portions have, on the other hand, a strong tendency to remain in diffusion throughout the bulk of the gas. Just in the same way, ammonia gas (which from its high vapour tension tends to remain diffused through the gas) is nevertheless partially absorbed by the condensed ammonia water.

These opposing forces of solution and diffusion depend for their relative values upon the temperature at the time of contact between the condensed liquids and the gases which hold the vapours in diffusion; for, as the temperature falls, the solubility of the vapours in the condensed liquids increases; while the powers of the vapours to remain in diffusion, simultaneously decrease.

These opposing forces also depend for their relative values upon the relative constitutions and proportions of the lower tensioned liquids and the higher tensioned vapours; or, to put this in another way, while the vapours may all be more or less soluble in the condensed liquids, still the vapour of some particular hydrocarbon may be present in such proportion as to be able to saturate the combined liquids. The result of this is that after this saturation has taken place, the force of diffusion is left unaffected by that of solution. Naphthalene, as will be afterwards explained, occupies such a position as this.

The power of condensed water vapour to take up the ammonia and acid gases in solution is subject to the same forces.

Modifications in Condensation.—By modifying the process of condensation, the action of these forces upon the gas and products may, within certain limits, be modified in such a way as to bring about small differences in the allocation of the condensable products between the gas and the liquid tars.

If the 10,000 to 11,000 cubic feet of gas, with the accompanying products obtained from the carbonizing of a ton of coal, be passed through a form of condenser which allows of the whole being cooled to atmospheric temperature while the tars and the gas remain in intimate contact, the liquid tars will exercise their full solvent affinity for the more volatile vapours, and will dissolve the maximum quantities of those vapours that they are capable of absorbing out of the given gas, as against the tendency of these vapours to remain in diffusion. In a similar manner, the condensed water vapour will take up in solution the maximum quantity of ammonia, acid gases, &c., which it is capable of absorbing out of the gas, as against the tendency of these vapours to remain in the gas in question. Under such conditions, the forces of solution would reach their practical maximum, and the forces of diffusion their practical minimum. On the whole, the condensed tars and water would leave the terminal of the condenser holding in solution the maximum weight of vapours they were capable of absorbing out of the given gas; and, on the other hand, the gas would hold in diffusion a proportionally less quantity of diffusible vapours. In fact, the result would be a balance between the forces of solution and diffusion, as regards the whole bulk of the gas and condensable products at the temperature of the terminal of the condensers.

If, on the other hand, the gas and condensable products were passed through a condensing arrangement in which the liquid tars and water were fractionally separated and removed from contact with the gas and vapours as the condensing and cooling process progressed, then the major part of the liquid tars and water would be precipitated and removed from contact with the gas and the remaining diffused vapours, at comparatively high temperatures. At these comparatively high temperatures, the solvent affinities of the liquid tars and water for the higher tensioned vapours are comparatively small, and the vapour tensions of the more volatile vapours are comparatively great. Under these conditions, the tars and water passing from the condenser will contain only such quantities of the more volatile vapours as they have been capable of absorbing from the gas at the temperatures at which they were last in contact with the gas; and in the long run the gas will pass from the terminal of the condensers holding in diffusion a proportionately larger quantity of the higher tensioned hydrocarbon vapours, and of ammonia, &c.

If the condensing process were still further modified by employing such a form of condenser that the fractionally condensed and precipitated liquids were made to flow backwards against the forward current of warm gas and vapours, the solvent power of the tars and water would become still further reduced, and the power of the gases to hold the higher tensioned vapours in diffusion would be correspondingly increased. The portions of the tars and the water deposited in the forward and cooler portions of the condensers, on flowing backwards and meeting the forward flow of the gases, would become hotter; and their solvent power for any vapours they might have absorbed would be correspondingly reduced. The result of this would be that a portion of the vapours dissolved in the condensate would be revolatilized into the warm gas, to be again carried forward to the cooler portions of the condenser, where their less volatile components would be recondensed; but the more volatile vapours would remain diffused through the gas, and be carried forward by it. Through conducting the condensation in this manner, not only would the gases and accompanying vapours from the coal be subjected to a fractional condensation, but the condensed liquids would be subjected to a partial fractional distillation. The more volatile vapours would be continuously driven forward to the cooler end of the condenser; and as the gas would come last into contact with a more volatile portion of the condensate, isolated from the solvent influence of the denser portions of the condensate, the balance of the forces of solution and diffusion would now be that between the more volatile and feebly solvent liquid deposited in the terminal of the condenser, and the gas left comparatively free to take up and retain in diffusion the more volatile vapours that are present.

Such, briefly stated, are the actions of the forces which theory, based upon natural laws, would indicate as those affecting the process of condensation.

Modifications in Products.—If these views be sound, it follows that, by modifying the methods of condensation of the gas and the accompanying condensable products, the relative proportions of the more volatile hydrocarbons may be modified in their distribution or allocation between the condensed solvent liquid tars and water on the one hand and the gas on the other, as these respectively leave the condensers. This distribution would, however, be largely dependent upon the composition of the condensable vapours; and at best it could only be stated as one of degree. In practice it would be almost impossible so to conduct the process of condensation as to get the conditions necessary to secure a perfect fractionation, and to prevent the solvent affinity of the liquid tars from dissolving out of the gas some of the hydrocarbon vapours which the gas could otherwise have held permanently in diffusion, at all ordinary temperatures. Neither would it be any more possible to carry on the process of condensation so as to prevent the gas which passes from the terminal of the condenser from holding in diffusion the vapour of hydrocarbons, which it could not hold permanently in diffusion at the temperatures to which it is afterwards liable to be subjected; and these are, under those circumstances, subsequently deposited.

Distillation of Tars.—When the 10,000 to 11,000 cubic feet of gas, with the 120 lbs. or so of hydrocarbon vapour obtained by the carbonization of a ton of coal, are subjected to condensation in any of the ordinary condensing arrangements, and by existing methods as applied in modern works, there are obtained approximately 120 lbs. of liquid tars. These tars hold in mechanical suspension from 25 to 30 lbs. of flocculent sooty carbon, and when

subjected to careful fractional distillation, from 2 to 3 lbs. of naphtha distil over before crystalline naphthalene makes its appearance. Thereafter the immediately succeeding portions of the distillate are so rich in naphthalene as to be quite solid on cooling, and these portions would choke up the condenser, unless it were kept hot. On the major part of the naphthalene distilling over, the distillate again becomes liquid; and it remains so until anthracene makes its appearance, whereupon the distillate again becomes pasty on cooling.

Constituents of Tars.—It is unnecessary for our purpose to go into the analysis of the tars further than to say that it shows that the 2 to 3 lbs. of distillate coming over before the naphthalene, and therefore having a higher vapour tension than that substance, are mainly composed of benzole and its higher homologues, with small quantities of other hydrocarbons, and that the hydrocarbons present in the tar and liquid at ordinary temperatures, with vapour tensions similar to that of naphthalene, are very small in quantity. This explains why naphthalene passing over, unaccompanied by solvent liquids, would choke up the condenser of the still unless this were kept sufficiently warm.

The quantity of naphthalene present in the tars from a ton of coal amounts approximately to from 12 to 14 lbs.; and in the tars naphthalene is far and away the most abundant individual hydrocarbon present. The quantity in question is more than the liquid hydrocarbons present in the tars could themselves hold in solution; and naphthalene is only prevented from separating out of the tar in a crystalline form by the presence of the sooty carbon and other substances with which it is associated.

Gas Treated with Dead Oils.—If the dead oils—that is, the oils which have tensions only equal to, or lower than, that of naphthalene, and from which the benzole homologues and other hydrocarbons, together with the naphthalene, have been removed by fractional distillation and filtration—are brought into contact with the gas as it leaves the terminal of the condenser, these denser oils at once re-assert their solvent power for the hydrocarbon vapours that have been left in diffusion, and dissolve them out of the gas. In the same manner ammoniacal water, if denuded of the dissolved ammonia by distillation, and then cooled and again brought into contact with the gas, will re-assert its solvent power, and will dissolve out the ammonia diffused through the gas; and just as it is possible, by fractionally applying the denuded ammonia water to the gas, to absorb the last traces of ammonia, so is it possible, by means of the dead oils, to absorb every trace of the volatile hydrocarbon vapours out of the gas. On heating in a still the denser oils that have been thus employed to dissolve the hydrocarbon vapours out of the gas, the solvent power of these denser oils is overcome; and the absorbed hydrocarbons have their vapour tensions raised and distil over. An analysis of the distillate thus obtained shows that the 10,000 to 11,000 cubic feet of gas leaving the condenser hold in diffusion approximately from 20 to 24 lbs. of hydrocarbon vapours, which have a constitution identically the same as that of the more volatile portions of the distillate of the tar. The more volatile benzol is present in quantities approximately from 16 to 18 lbs., with from 2 to 6 lbs. of the higher homologues of benzol, together with small quantities of other hydrocarbons, including from 0·10 to 0·14 lb. of naphthalene. It may be desirable at this point to explain that the 20 lbs. or so of hydrocarbon vapours in the gas is not nearly all that it could take up in diffusion.

Solvent Power and Diffusion.—Through ascertaining, by the distillation of the tar, the quantity of the volatile hydrocarbons it holds, we obtain a measure of the solvent power of the liquid tars—their power to dissolve out of the gas those volatile vapours which would otherwise tend to diffuse through the gas. And through absorption of the diffused vapours out of the gas, by means of the dead oils, we get a measure of the quantity of volatile hydrocarbon vapours that can be held in diffusion through the gases, as against the solvent power of the liquid tars.

Crystallization of Naphthalene.—There is one other force that it is necessary to take into consideration—that is, the force of crystallization, so far as it affects the process of condensation. All the hydrocarbons which are present in tars, and which are liquid at ordinary temperature, are soluble, or at least miscible, in each other in all proportions; and remain equally diffused through each other when mixed. With the hydrocarbon naphthalene, the state of matters is very different. It is only soluble in the liquid hydrocarbons in certain definite proportions at given temperatures. Whenever the conditions are such that the naphthalene is present in quantities greater than can be held in solution in the liquids, the excess, by the force of crystallization, is, or tends to become, separated as pure crystalline naphthalene.

Another characteristic of naphthalene is that, on assuming the crystalline state, it loses its solvent affinity for the hydrocarbon vapours present in the gas. Illuminating coal gas can be passed through a mass of crystalline naphthalene without suffering loss in illuminating power. On the other hand, all liquid hydrocarbons, such as have a vapour tension similar to that of naphthalene—even the liquid oils that have been distilled along with the naphthalene and have been separated from it by cold and filtration—when brought into contact with the gas at once absorb the illuminating hydrocarbons.

Although naphthalene in the crystalline form has no solvent affinity for the other hydrocarbon vapours in the gas, yet if naphthalene vapours are present in the gas to supersaturation, any crystals of naphthalene previously deposited form a nucleus on which the naphthalene vapours are preferably deposited, in the solid state; and, on the other hand, any crystals of naphthalene tend to pass directly from the solid state to the state of vapour into a gas not saturated with naphthalene, when such gas is brought into contact with them. Possessed of these facts, we are now in a position better to understand the conditions which obtain in the different methods of condensation.

Condensation and Distillation Compared.—The process of condensing the gas and products coming from the retorts is, in a sense, practically the reverse of the process of distillation of the tars. In the process of distillation, the tars are placed in a still and gradually heated. The vapour tensions of the different hydrocarbons are thus successively raised, until they become equal to that of the atmosphere. Those with the higher vapour tensions distil over first, and are followed successively by those of lower vapour tensions, as heat is imparted to raise their tensions successively to that of the atmosphere. The vapours are all successively evaporated in the presence, and from the surface, of the liquid tars remaining in the still.

In the process of condensation, the whole of the condensable hydrocarbons leave the retorts in the form of vapour; and by the withdrawal of the heat from the vapours, their tensions are reduced until they fall below that of the atmosphere. Then they pass into the liquid condition; the vapour with the lowest tension condensing first, followed by those of higher and higher tensions, as more and more heat is withdrawn. In this process, the vapours are all successively condensed from, and in presence of, the vapours which still remain uncondensed.

The only essential difference between these reverse processes is that, in the case of condensation, the condensable hydrocarbon vapours leaving the retort are accompanied by the permanent gas; and, as a consequence, the tension of the gas, or the tendency of the gas to hold the vapours in diffusion, is added to that of the hydrocarbon vapours, for which reason the temperature at which the vapours condense in the presence of the permanent gas is so much lowered that the more volatile vapours which, if pure, would be condensed to the liquid state at ordinary temperatures, are, by the added tension of the gas, held in diffusion.

In the process of distilling the tars, on the other hand, as we have already seen, the benzol and its homologues, together with other hydrocarbons of high vapour tensions, distil over first. Thereafter the crystalline naphthalene makes its appearance in such quantities, and accompanied by so small a quantity of other hydrocarbons that are liquid, that it crystallizes, and would choke up the still condenser unless the temperature were kept high; and, after the bulk of the naphthalene has distilled over, the distillate again becomes liquid till the anthracene appears, when it again becomes pasty on cooling.

Theoretical and Practical Results.—Now, seeing that the process of condensation is the reverse of that of distillation, it would naturally follow that in the process of condensation the reverse sequence of conditions should obtain. We might accordingly expect the pasty hydrocarbons to be first precipitated, carrying with them the sooty carbon.

Thereafter the comparatively liquid tars, followed by the deposition of crystalline naphthalene; and finally the precipitation of any excess of the more volatile benzol, its homologues, and other hydrocarbons of high tensions beyond the amounts which the permanent gas could hold in diffusion.

Such undoubtedly would be the sequence of precipitations of the vapours out of the gas, provided that conditions could be realized such as would bring about a sufficiently perfect fractional cooling, and the precipitation and continuous removal of the condensate. In practice, however, it is impossible to realize such ideal conditions, either during the distillation of hydrocarbon liquids, or in their condensation. This is because the solvent fluids in the still retain small quantities of hydrocarbon vapours that would distil over were it not for the solvent power of the liquid; and, again, because the more volatile vapours in the still take up in diffusion dense vapours which would otherwise remain liquid. The same considerations affect the process of condensation; but, of course, in a reverse manner. Hence the impossibility of effecting the separation of liquids which have different vapour tensions by a single distillation or condensation. Besides, there is in the condensation of coal gas and its products the further difficulty that, when hot gas holding vapours in diffusion is more or less suddenly cooled, the vapours on passing into the liquid state are liable to do so in an extremely fine state of division. The more quickly the cooling is effected, the finer is this state of division; and if at the same time that the gas is suddenly cooled it is driven forward at a high velocity, these finely-divided liquid particles are apt to be carried forward in the current of gas through long distances.

Attempts to Solve the Problem.—These facts have been fully recognized, and many different arrangements of condensing plant have been devised in order to overcome the objectionable conditions, such as carrying mains of large area round the walls of the retort-house, so that the warm gas might be slowly cooled in the warm house while it travelled slowly, in order to allow the floating condensed liquids to coalesce and precipitate out of the gas, before final cooling in the condenser to the temperature of the atmosphere.

There have been many other arrangements, with some of which the author was connected more than twenty years ago, by which not only were the products slowly fractionally cooled, but the condensed liquid products precipitated out of the gas were themselves made to travel against the current of warm gas and products; and in some cases the liquid tars were even warmed up, not only by the gas, but by heat from other sources, and were thus subjected to a fractional distilling process, as well as to a fractional condensing process.

Such arrangements of condensing plant undoubtedly presented advantages, more particularly where cannel coal was used, or even where common coal was used at lower temperatures than is now the practice, and when naphthalene was not an abundant product. The advantages, however, are questionable, under modern conditions, in which the coal is carbonized at such high temperatures as greatly to alter the constitution of the tars, and to cause naphthalene to be present in such excessive quantities.

Practical Experiences.—Some time ago, the author was consulted by an eminent gas engineer connected with a large provincial town in England, who had been experiencing grave troubles from naphthalene deposits. He had visited a great many other works, where coal was being used of the same or a similar class to that used in his own works. Some of these works had had troubles like his own; while others were comparatively free from naphthalene difficulties. He observed—and the author was particularly struck with his faculty of observation—that in the works where condensation was carried out on what was universally believed to be the best principle (that of slowly cooling the gas and removing the liquid tars as they were precipitated), it was found that there the troubles from naphthalene were greatest. On the other hand, in those works where the gases and condensable products were suddenly cooled, and no attempt was made to fractionally condense the gas and separate the tars as they were formed, the troubles from naphthalene deposits were least.

Explanation of the Results.—Applying the facts and theories which we have been considering to these conditions, the explanation of those results is simple. In the works provided with condensing arrangements for slow fractional cooling of the gas and vapours, and for removal of the liquid tars from contact with the gas as soon as they are precipitated, the best practicable conditions are provided for restricting the solvent affinity of the tars, and for allowing the more volatile vapours to be carried forward in the gas. Now what are those vapours? We have seen that the most volatile hydrocarbon vapours present in the gas as it leaves the retort are benzol and its homologues, with small quantities of other hydrocarbons; that the quantity of these accompanying the gas is not nearly sufficient to saturate the large volume of gas; that the hydrocarbon presenting the next highest tension is naphthalene; and that this hydrocarbon is present in very large quantities. It is evident that the naphthalene will be the hydrocarbon carried forward in large quantities to the cooler end of the condenser; and as the quantities of vapours having tensions similar to that of naphthalene are extremely small, the naphthalene will pass directly from the state of vapour into that of a solid, and will be deposited on the walls of the condenser in the crystalline form. That such is the result is fully borne out by practical experience; the choking up of the terminal end of the condenser with crystalline naphthalene being a common experience.

In the Condenser.—As the quantity of hydrocarbon vapours which have tensions higher than that of naphthalene is never sufficient to saturate the gas, it is evident that under such conditions the gas coming last into contact with any naphthalene crystals deposited on the walls of the condenser will leave the condenser practically saturated with naphthalene vapours, at the temperature of the terminal of the condenser. This is necessarily so; for in whatever way the temperature may vary, naphthalene crystals will be presented to, and brought into contact with, the gas as it leaves the condenser. Should the temperature be very low, a further quantity of naphthalene will be added to the crystals. Should, on the other hand, the temperature rise, a portion of the previously deposited naphthalene would be sublimed or volatilized with the gas. Had the naphthalene condensed as a liquid, such conditions could not have prevailed, because it would have flowed out of the condenser as it was precipitated, and away to the tar well.

The zone, so to speak, or the portion or region of the condenser in which the naphthalene will be thus deposited and re-volatilized into the gas, will vary with changes of the atmospheric temperature, variations in the makes of gas, &c. As the atmospheric temperature falls, or the make decreases, the zone will retreat towards the inlet end of the condenser; and, *vice versâ*, on a rise of temperature, or an increased make of gas, the zone will be driven forward nearer the terminal cold end of the condenser, and might even, under exceptional circumstances, such as sun's rays falling upon the terminal end of the condenser, be driven forward out of the condenser altogether, into the other portions of the plant.

The same conditions which would lead to variations in the position of the zone of naphthalene deposition in the condensers would have a like effect in altering the zone of deposition of the liquid tars; and it is conceivable, indeed very probable, that an advancing zone of depositing liquid tars may be, under certain conditions, driven forward at such a rate as to overtake the advance of the zone of naphthalene. Under such circumstances, the naphthalene, instead of re-volatilizing into the gas, would be to a large extent dissolved by the tars, and carried away out of the condenser by them; and there is little doubt that such conditions are being constantly brought about in every-day practice, otherwise the condensers would choke up much more quickly than they do.

Mr. Carpenter has devised an ingenious arrangement for condensing, by which the zone of depositing tars can be made to overlap the naphthalene zone at will, by alternately reversing the current of gas and products, and thus making each terminal of the condenser alternately the inlet and the outlet. During the period of the overlapping of the tar and naphthalene zones, a part, and no doubt the major part, of the naphthalene is dissolved by the liquid tars, and passes away in solution along with these; but a small portion of the naphthalene is sublimed or volatilized, and carried forward in the current of gas. A part of this portion might be carried right through the condenser into the scrubber.

In those works which were provided with condensing arrangements, in which the gas was suddenly cooled, the

tar vapours would be reduced to the liquid condition, but in such an extremely fine state of division that they would keep floating forward in the current of gas; and long before the major part of them was removed by coalescence, by friction on the walls of the pipes, or by impact on the bends, they would be so reduced in temperature that the bulk of the naphthalene vapours in the gas would be absorbed and dissolved. Then, further, the presence of the remaining more finely divided tars would so interfere with the forces of crystallization as to prevent the naphthalene being deposited in the crystalline form; and consequently the naphthalene would be removed from the condenser along with the tars, instead of being deposited as crystals on the walls of the pipes of the condenser. No doubt the gas would pass from the condenser still polluted with small quantities of tar particles and still containing naphthalene vapours in diffusion; but the tar particles would be removed in the washer and scrubber. The naphthalene left in diffusion through the gas would be smaller in quantity, and not liable to violent fluctuations. Such fluctuations do result, on the other hand, from the conditions presented in the fractional method of condensation. Under that method, we have crystals of naphthalene continuously presented to the gas during considerable changes of temperature at the terminal of the condenser, or at the point of last contact.

There is also no doubt that, under the method of sudden cooling, the conditions of contact between the liquid tar particles and the gas, which resulted in the solution of the naphthalene, would further enable the tars to dissolve out of the gas some of the benzole and other vapours that would otherwise have remained permanently diffused through it. From a series of experiments made many years ago, the quantity of those higher tensioned vapours so absorbed was, however, found to be extremely small; and this absorption did not reduce the illuminating power, under ordinary temperature conditions, to any very appreciable extent. The reason for so small a loss is that, when coal is carbonized at a high temperature, the quantity of those hydrocarbons which have a higher tension than naphthalene falls so very far short of what would be necessary in order to saturate the gas, that the absorption of a very small quantity of these more volatile hydrocarbons is sufficient to establish a balance between the solvent power of the tars and the power of the large volume of gas to hold the rest of the more volatile hydrocarbon vapours in diffusion.

It is unnecessary, for our present purposes, to discuss those two methods of condensation, as applied to the condensation of the gas and products from ordinary gas coals carbonized at high temperatures, further than to say that both theory, founded upon the action of natural laws, and practical experience, would point to a modification of both as being what is desirable—viz., to get the liquid tars precipitated out of the gas, and yet not to remove the tars and gas from contact with one another, but to keep the tars and gas in intimate contact until both are comparatively cold.

In the Washers and Scrubbers.—We have seen how the crystalline naphthalene is, under certain conditions, driven forward right through the condenser into the succeeding parts of the manufacturing plant. The washers and scrubbers, the next part of the plant, after passing the exhauster, are seldom covered in; and, being exposed, they are subject to considerable variations of temperature. When the temperature in the washers and scrubbers was low, the naphthalene driven forward into them would be partially deposited upon the surface of the moving liquids. The naphthalene crystals deposited under such conditions would be extremely small; and the small quantity of liquid tars present would be also in part entangled in the washing water. In this way, a part of the naphthalene passing forward out of the condensers would be removed along with the washer water; but, besides that, another part of the naphthalene would be deposited in the form of large crystals in the empty spaces, in the pipe connections, and upon solid surfaces. This deposit of crystalline naphthalene would remain there till there was a rise in temperature, say through increased warmth of the atmosphere, or in consequence of the direct action of the sun's rays; and then these deposited crystals of naphthalene would begin to be re-volatilized and carried forward into the purifiers.

In the Purifiers.—The purifiers are generally covered in, and, not being exposed, are not subject to such violent changes of temperature from external causes; but they are subject to great changes of temperature from the chemical action which takes place within them. The temperature of the purifying material in that purifier through which the gas enters the series of purifiers is always warmer than the temperature of the atmosphere; its temperature having been raised by the previous chemical action, the absorption of the acid gases from the coal gas. The naphthalene-charged gas, upon entering the series of purifiers, will not be reduced but rather raised in temperature; and, therefore, there will be no naphthalene deposited at this point.

The purifying material, when charged into the last purifier of the series, is necessarily of the same temperature as the air. In order to ensure that the gas will not pass the purifiers and yet contain traces of impurities, the last purifier is charged sooner than is absolutely necessary; and the gas must pass through it for some time before chemical action begins. The warmer naphthalene-charged gas, on coming into contact with this newly-charged purifying material, is necessarily reduced in temperature. As a consequence of this, a part of its naphthalene vapour is deposited on the surface of the cold material, as also upon the cold purifier walls, covers, &c. This cooling of the gas, and deposition of naphthalene, continues until the current of warm gas, and possibly the advance of the zone of purification and chemical action, sufficiently raise the temperature of the purifying material. Thereupon the deposition of the naphthalene stops, and the reverse action begins. From this stage, the naphthalene which is present in the gas that enters the purifier passes on; and what was previously deposited during the cool period is now being re-volatilized by the heat of the chemical action taking place within the purifier. A small quantity of the naphthalene may be left upon the surface of the purifying material and removed with it; but the great bulk of the naphthalene leaving the scrubber is more or less subjected to this alternating action.

The result of this alternating action in the purifiers is that, during the cold period, when the purifier has been newly charged, the gas traversing the last purifier of the series will have the naphthalene vapours present in the gas reduced in quantity; and what remains will only have a vapour tension equal to that of the cold purifying material. Therefore, should the gas passing from the purifier during that period be subsequently raised in temperature, if brought in contact with naphthalene, it could, and would, take it up in diffusion, in quantities corresponding to the rise in temperature. On the other hand, during the hot stage, the gas would pass from the purifier more and more highly charged with naphthalene as the temperature rose; and if it was subsequently lowered in temperature, it would deposit naphthalene.

In some correspondence which appeared in the "JOURNAL OF GAS LIGHTING" some years ago, Mr. A. F. Browne furnished conclusive evidence that such was the actual condition which obtained in practical working. Mr. Browne explained that, at the Old Kent Road Gas-Works, it had been customary for several years to watch, through glass windows, the outlet-main at the station meter; that thermometers inserted in these mains close to the glass windows showed the average temperatures in that main to be 4° higher than at the inlet to the purifiers; that in these mains naphthalene in the crystalline form was observed to be deposited, and to go on increasing for a time, and that it subsequently diminished, and even disappeared with great rapidity; that this rapid re-volatilization took place immediately on charging the last purifier with fresh material; and that, after a time, naphthalene again began to be deposited, and continued to be so till the purifier was again charged with fresh material. This proved that the gas was alternately under and supersaturated with naphthalene, even at a temperature 4° above that of the gas entering the purifier; and that those alternating conditions of the gas were due to the changes of temperature which took place at the different stages of purification.

It will be noted that, although the naphthalene crystals were alternately deposited and re-volatilized, there was yet no permanent accumulation of naphthalene in the meter outlet-main. This showed that a main having a mean temperature above that to which the gas has been previously exposed will not get choked with naphthalene so long as the alternations of temperature are confined to short periods of time.

At the Holder.—The gas leaving the meter passes on to the gasholder, and on its way it has to pass the inlet to the gasholder, which is deeply buried on the outside of the tank; and the gas has then to pass up through the mass of water inside. While thus situated at a depth, the gas is not liable to violent fluctuations of temperature; but for a great part of the year the mean temperature to which the gas is exposed at this stage is below the mean of the fluctuating temperatures to which it has been previously exposed during its condensation and purification. The result, as is well known, is that the gas during that period of the year deposits more naphthalene than is re-volatilized; and the main becomes gradually choked up with the excess, even although the pipe be of considerable diameter.

In this gasholder, during the period of storage, and in the distributing plant above ground, the gas continues to be exposed to rapid changes of temperature, similar to those in the condensing plant. The underground mains, although not subject to such sudden changes, are yet subject to slower changes of temperature, which play an important part in producing troubles from naphthalene deposits.

We have all observed and admired the beautiful crystals of water deposited upon our room windows after a severe night's frost. These crystals are derived from the moisture diffused through the warm air in the room, on its coming in contact with the cold panes of glass. The tension of the water vapour being thus rapidly reduced, the moisture passes from the state of vapour to that of a crystalline solid, assuming those beautiful feathery forms we so much admire. If there were a supply of moist air entering the room, while the cold air, denuded of its moisture, passed away, the continued supply of moisture-laden air would deposit its vapours upon the surface of the cold existing crystals, thus adding to their beauty and volume. On a rise of temperature, due, let us say, to the fires being lighted, or to the sun's rays striking the windows, the previously deposited moisture will ultimately evaporate into the warm air and pass away in the air currents.

In a gasholder containing gas holding naphthalene and other vapours in diffusion, a very similar set of conditions would prevail. On a frosty night, the plates of the gasholder would play the part of the cold windows, only more perfectly so, on account of their greater surface and their better conducting power; and if we could only see the inside of these plates after such a night, we would find them, like the window panes, coated with a beautiful deposit of crystals. These crystals would, however, not be pure water crystals, but would be associated with crystals of naphthalene; and if the temperature were extremely low, even some of the other vapours of those hydrocarbons which have higher tensions than naphthalene would be condensed to the liquid state. These hydrocarbon liquids would, in that case, condense upon the crystals, and would dissolve a portion of the naphthalene, which would flow down with them and collect on the surface of the water in the tank. If the temperature were low, but not below that of the freezing point of water, then the water vapour would pass out of the gas as a liquid, and flow down into the tank; while the naphthalene would still, owing to its high melting point, be deposited on the cold plates as a crystalline solid. Then, in the event of a current of naphthalene-charged gas passing into the holder, the naphthalene vapour which it contains would go to add to the crystals already deposited.

In the Mains.—The gas leaving the holder during this low temperature period would, to a large extent, be denuded of naphthalene vapours; and as it would not in all probability be exposed on its further course to any temperature lower than that to which it had been subjected in the holder, it would give no trouble during distribution, unless subjected to certain conditions which will be subsequently considered. If, however, after a longer or shorter period of low temperature, the temperature should rise (say) during a bright sunshiny day, the naphthalene and other hydrocarbon vapours previously deposited in the holder would be re-volatilized into the gas; and the gas would pass into the distributing mains more or less highly charged with naphthalene vapour, to an extent dependent upon the temperature at the holder. The gas thus charged with naphthalene would be very liable to give trouble, as whenever its temperature was reduced below that to which it was exposed in the holder, it would deposit naphthalene crystals.

Where these crystals would be deposited, and whether they would give trouble or not, would depend upon a number of conditions; but the main factor would be the mean temperature of the buried mains, and the fluctuating atmospheric temperature dependent upon the season of the year. If, in the first place, the mean temperature of the buried mains was below the mean of the fluctuating surface atmospheric temperature at the holder, then the excess of naphthalene vapours carried forward from the holder by the gas during the short periods of high surface temperature would be mainly deposited in the large trunk mains fairly near the works, and would not be so liable to give trouble. On the other hand, during other periods of the year, when the mean temperature of the buried mains was above the mean surface atmospheric temperatures at the holders, the excess would not be deposited in the mains, but would pass on with the gas. Not only would that be the case, but the naphthalene crystals deposited in the mains when the temperature was below the mean of the surface temperature would now be re-volatilized into the gas. The gas thus left loaded with naphthalene, on reaching the comparatively shallow small mains and exposed services, subject, as these are, to fluctuating surface temperatures, but on the whole colder than the mains, would deposit the excess of naphthalene there in fine feathery crystals, and choke them up, thus giving rise to no end of trouble.

The former set of conditions we find after the mean surface temperatures begin to rise during the late spring and early summer, at which period the mean temperature of the earth at the depth of the mains is below the average mean temperature of the atmosphere. The latter conditions prevail in the autumn and early winter, after the summer heat has warmed the earth to the depth of the mains, and when the average mean surface temperature of the atmosphere falls below that of the buried mains. The troubles from naphthalene deposits during the continuance of the latter conditions are accentuated by the great and rapid fluctuations of temperature which frequently take place in the late autumn and early winter. During such periods, the troubles from naphthalene are often excessive.

General Conclusions.—There are many minor causes leading to troubles with naphthalene, such as the precipitation of the naphthalene as extremely fine crystals, and the drifting forward of these in the current of gas, &c.; but it would take more time than is at our disposal, and, besides, it is not necessary for our present purpose, further to consider these. Sufficient has been said to show the important part which the crystalline condition of the naphthalene plays in producing the troubles experienced from the presence of naphthalene vapours in the gas, and also to explain what has been regarded as the eccentricity of the behaviour of naphthalene, and to show that these apparent eccentricities are in perfect harmony with well-known physical laws. The naphthalene which is the source of trouble may not have been produced at the works immediately before it makes itself manifest in the distant distributing plant, but may have been produced at the works weeks or even months before; and it may, during the interval, have been travelling forward by a series of successive crystalline depositions from and evaporations into the gas, till it reaches the place where it is finally deposited, and occasions trouble by choking up the branch mains or service pipes.

The Remedies.—The question naturally arises, what are the remedies for these troubles? The answer is that they are of two kinds. The first consists in removal of the naphthalene vapour from the gas, or, at least, in removing such a quantity of those vapours as would prevent them from being deposited during the subsequent distribution of the gas. The second consists in adding to the gas something that will prevent the naphthalene vapours present in the gas from being deposited in the crystalline form. The solution of these problems is to be found in a further application of those forces which we have just been considering.

We remove the ammonia left diffused through the gas, beyond what can be absorbed by the water condensed from the gas in the condensers, by a further quantity of the same solvent water. That further quantity of water may be a part of the ammoniacal liquor obtained from the condenser, after the ammonia has been separated from it by distillation.

In the dense oils as obtained by the distillation of the condenser tars, and freed from naphthalene, we have an

excellent solvent for naphthalene, as well as for the other hydrocarbons diffused through the gas. If, however, the benzol and other high tension vapours obtained from the distillation of the tars are returned to the dense oil, the solvent power of the dense oil for the benzol and other high tensioned vapours present in the gas is balanced, and the solvent power of the oil is thus restricted to dissolving out the naphthalene. It is, therefore, evident that if the dense oil thus prepared was applied to the naphthalene-charged gas after the fashion of the prepared ammoniacal liquor or solvent water in the case of the ammonia, the naphthalene vapour could be as perfectly removed from the gas as it was possible to remove the ammonia by water; and that just as the ammonia absorbed from the gas could be separated by the distillation of the water, so also could the naphthalene be similarly separated by the distillation of the dead oil.

The second remedy, or rather preventative, is to evaporate into the naphthalene-charged gas such a quantity of liquid hydrocarbon vapours having vapour tensions approximately the same as that of naphthalene, that when the temperature of the gas falls so low as to cause the vapour of the naphthalene to be precipitated, there will simultaneously be condensed such a quantity of the vapours of these liquid hydrocarbons as will take up the precipitated naphthalene in solution.

The hydrocarbons for both objects may be obtained from any convenient source. A ready means of obtaining a supply of hydrocarbon liquid for either or both purposes, where other sources of supply are not available, is to carbonize a portion of the gas coal at such a low temperature as will produce liquid tars comparatively free from naphthalene but rich in vapours having vapour tensions similar to that of naphthalene. The naphthalene-charged gas, as it leaves the ordinary condenser, when mixed with the hot gas and products from the coal carbonized at the lower temperature, has the major part of the naphthalene vapours dissolved out by the liquid tars as these are precipitated; while, at the same time, the gas takes up in diffusion the vapours of hydrocarbons which have tensions approximating to that of naphthalene. These are present in large quantities in the low temperature products; and, during the distribution of the gas so treated, they prevent any naphthalene which may remain from being deposited in the crystalline form, for these vapours condense along with it, and take it up in solution.

When it is desired not only to remove the naphthalene from the gases produced from coal carbonized at high temperatures, but also to raise the illuminating power, that object can be most conveniently—and, with 90 per cent. benzol at its present price, very economically—effected by adding to the dense oils, used to remove naphthalene, more benzol than is necessary to balance their solvent power for the benzol present in the gas. The excess quantity volatilizing into the gas would raise the illuminating power; and, by regulating the quantity of benzol so added, the desired illuminating power can be maintained with great regularity.

Where cannel coal is available at a reasonable price, the same objects may be obtained, even more economically, by carbonizing the cannel at lower temperatures than that employed for the gas coals. The cannel coal carbonized at the lower temperature yields liquid products which have a very high solvent power for naphthalene; and it also yields a large volume of hydrocarbon vapour, which can be taken up in diffusion through the gas, and which possesses an enriching value of nearly twice that which can be obtained from the same cannel carbonized at higher temperatures along with the ordinary gas coals.

Discussion.

The PRESIDENT, in opening the discussion, said he did not intend to make any remarks upon the paper, as there were so many gentlemen present who had had great experience of this elusive compound.

Mr. J. P. LEATHER (Burnley), on being called on by the President, said he had not much to add to what he said last, and to what was given in the paper. There was nothing in the paper but what he entirely agreed with. His further experience confirmed the opinion of Mr. Young that it was possible to take the naphthalene thoroughly out of the gas, without deterioration of the gas, and without incurring any great cost; and, of course, if the naphthalene was taken out, it could not give trouble afterwards.

Mr. J. W. MORRISON (Sheffield) said it was pretty well known that at Sheffield they had been very seriously troubled with naphthalene. There were three works. At the Grimesthorpe station, they had been practically free since the works were started, and remained free up to the present. There they had settings of ten retorts in each bed; and they ran at pretty high heats to carbonize the coal, which consisted of slack and small nuts. With these conditions, anyone would expect to find a very large quantity of naphthalene in the gas. The foul mains on these works were originally intended for a production of 5 million cubic feet; but at present they were not making more than 2½ million cubic feet. He had recently had occasion to open a Clapham washer which had become temporarily blocked; and after turning steam into it for a few days, the first purifier they opened was found to contain very heavy crystals of naphthalene. This had not been noticed before or since. There had been no complaint in the district; and it puzzled him to find the naphthalene there. At another works, which supplied rather a hilly district, they had been very much troubled formerly; and he was sorry to say the complaints had started again this year. They had generally found that the worst trouble was in the higher districts, in cold clay ground, and where the mains ran to a dead-end. Where they had been able to couple them round, they had in many cases been able to get rid of recurring complaints. He had also had experiments conducted by passing gas containing naphthalene through the lighter tars taken from the foul mains and the condensers; and so far the results had been very satisfactory. He was at present collecting the tars, with the idea that if the naphthalene difficulty should again crop up, they would be able to wash the gas in the lighter tars; and they had found by experiment that, by keeping the tars at a temperature just over 90°, they could remove the naphthalene without robbing the gas of any illuminating power.

The PRESIDENT expressed surprise that there should be such unanimity on this question of naphthalene, upon which he had understood there had hitherto not been much agreement. There seemed to be no difference of opinion that it could be cured; and this was a great blessing for gas producers. It would be a mercy for one or two of his own clients who had been growling about it very considerably, and who had not yet been able to cure it. After hearing the paper, he would doubtless be able to advise that the removal of naphthalene was as easy as getting the ammonia out of the gas. They were indebted to Mr. Glover for having read Mr. Young's paper.

Mr. GLOVER said he did not think it necessary to add anything to what had been contributed in the paper. Mr. Leather's further experience confirmed the experience he related twelve months ago, and Mr. Morrison also confirmed the method of removing naphthalene from coal gas, by washing the gas in the lighter tars, which were, of course, excellent solvents of naphthalene. He was sure that, if Mr. Morrison would carry out this process on the lines put forward by Mr. Young, he would eventually find a complete cure for naphthalene at all his works.

The Behaviour of Acetylene towards Hypochlorites.—On account of the contradictory statements which have been promulgated with regard to the behaviour of acetylene towards hypochlorites, of which some—notably chloride of lime—have been suggested as purifying agents for that gas, experiments have been made by Mr. J. W. Blagden, with a view to elucidate the matter. The account of the researches appears in "Acetylen in Wissenschaft und Industrie." The author is referred to as of Darmstadt; but our readers will recognize him as the son of Mr. Blagden, of the Gaslight and Coke Company. On leaving Cambridge a few years ago, he went to Germany to pursue his chemical studies. In the work of which we now have the report, he used carefully purified acetylene, and both chloride of lime and sodium hypochlorite. When the acetylene was passed through an alkaline solution of the sodium salt, it was found to be contaminated with chlorine; and, on titrating the solution before and after the passage of the gas through it, it was found that the amount of hypochlorite in the solution had been considerably diminished by the action of the passing acetylene. A solution of chloride of lime, however, under similar conditions, scarcely showed any change. Even smaller still was the extent of the action when solid chloride of lime was used. In fact, it was within the limits of error of the estimation of the chloride of lime. This point is of great importance with regard to the purification of acetylene with chloride of lime or mixtures containing it, as it demonstrates that no interaction is to be feared in such cases. Clearly, however, sodium hypochlorite cannot be used to purify acetylene.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1739.)

THE condition of the Stock Markets in general continues in the same unsatisfactory state. They seem quite unable to throw off the listless semi-inanimate mood which has persistently oppressed them for some little time past. Certainly, events in China are looking serious. But they scarcely constitute a sufficient reason for so much depression by themselves; and there is no other factor in sight to exercise any downward pressure. The public are doing nothing; and day after day quiet ruled through the past week. There was a slightly better feeling about the middle of it. But it soon fell away; and in view of the Exchange being closed on Saturday, everything settled down to its old quietude. Prices are lower pretty well all through the list, from Consols downwards. The Money Market remained for some days very easy; but towards the close there was a better demand. With the Stock Exchange settlement this week, and the requirements at the end of the half year, rates are likely to keep up for another week. Business in the Gas Market was just as limited as in any other department, and was not marked with any noticeable characteristic. Movements, too, were for the most part slight and irregular. In Gaslights, there was a fall in the ordinary stock in response to the Directors' announcement of a rise of 6d. in the price of gas—a rise which reduces the authorized rate of dividend for the second half year by 12s. per cent. In consequence, the ordinary stock again fell to a discount, and was marked at 99 on Friday. The secured issues were not affected. Very little business was marked in South Metropolitan; and the buying price was lowered. Commercials were in good favour; and the old stock advanced five points. We understand the Company have just made a successful issue of further capital at a premium; the stock offered being over applied for. Hardly a transaction was marked in the Suburban and Provincial group; and quotations did not vary. The Continental Companies were quite as inactive as the rest; and, beyond some changes in Imperial which terminated in lowering the buying price, nothing moved. The undertakings in remoter parts of the earth made no sign. Business in Water resumed its usual quiet appearance. But firmness was well maintained; and two or three quotations advanced.

The daily operations were: On the opening day, there was a marked absence of business in Gas; and the tendency was in the direction of easier figures. Gaslight ordinary and South Metropolitan receded 1 each. In Water, Grand Junction rose 1. On Tuesday, a few dealings in Gaslights saved the department from absolute inanition. The only change was a fall of 1 in Imperial Continental. Wednesday was quite the counterpart of Tuesday, without any change at all. In Water, Southwark ordinary rose $2\frac{1}{2}$. On Thursday there were a few more transactions, and Commercial old moved up 5. But Gaslight ordinary receded 1. Friday was quite the most active day of the week; but all quotations closed unchanged.

ELECTRIC LIGHTING MEMORANDA.

The Lancashire Electric Power Scheme—Electric Power Transmission Generally—Two Much "Wild Cat"—Alderman Higginbottom on the Cost of Electric Motors.

THE House of Commons Committee on the Electric Power Bills sat again last week, taking first the part-heard case of the Lancashire Company. The opposition of the municipal boroughs and other local authorities to the scheme of the promoters is very strong. They object to a Company of traders with statutory rights coming into their midst under pretences which they do not believe have any foundation in fact. Many of these authorities have electricity supply undertakings of their own; and besides Lancashire is notoriously a hot-bed of municipalism. On the question of the merit of bulk-generation of electricity in this region, the representatives of the municipalities give a flat contradiction to the declaration of the preamble of the Bill. They allege that there would be no economical advantage in such generation, because the area is too large. Whatever might be the initial advantages of pit-head power generation, these it is argued must disappear in the subsequent transmission of the power. The cost of carrying a trunk cable from the nearest proposed generating station to Clitheroe is estimated at £45,000; and accordingly the local people scout the Company's scheme as wild, ridiculous, and absurd. The Manchester Corporation see no advantage in the Bill. Alderman Higginbottom told the Committee that the Manchester Corporation already supply electricity over an area of 45 square miles, which is quite enough to make their power generation rank as "bulky." Mr. Wordingham, also, the Corporation Electrical Engineer, stated that there is no economy to be got by generating power on a larger scale than 20,000 or 30,000 horse power. The only possible saving by the scheme contemplated by the Bill is in the carriage of coal; and this must be altogether swamped by the high cost of the mains to the area of supply. "He did not believe it was commercially possible to carry electricity long distances in this country."

This observation of Mr. Wordingham is exactly on the lines of our own judgment of this electricity-in-bulk generation craze. We have never been able to see its commercial advantages anywhere, except perhaps in a few particular examples in Switzerland, which our professional electricians are not at all fond of talking about. As for these English schemes now in Parliament, it appears to us to be just within the bounds of possibility that a well-designed power plant might answer in Durham or South Wales. The result, however, must depend entirely upon the circumstances of the transmission and distribution. It is not a question of generation at all; and Mr. Wordingham is conspicuously correct in resting the economic result of any such scheme on the question of carriage. The truth of the matter seems to be that it is the legend of the Niagara power affair which has turned the heads of certain people, and created the popular delusion that there is money, and progress, and all the rest of it in mere power generation on the largest scale for subsequent transmission electrically. It is scarcely necessary to repeat here what has so often been observed as to the expediency of receiving with the greatest caution all the claims that have been advanced for the success of the Niagara business. But even so, it is understood that power can be generated when and where English coal is cheap at a cost which compares favourably with the prime cost of electricity at Niagara. This is not the main point that has to be considered, which is, what can be done with the power after it is generated.

Such commercial success as the Niagara Company can truly claim is due to the unique circumstance that in their case the consumer has come to the source of power. When Mr. Wordingham said that electric power distribution over long distances is not practicable in this country, he might have said that it is not an economical business anywhere, unless coal is not to be had. There is no prospect of a big power scheme on the Niagara pattern—where the user goes to the power—succeeding in this country; because the proportion borne by the cost of power to the total working expenses of any ordinary industry is too small to be worth considering. One or two calcium carbide factories will serve a country; and what other industry is there in which cost of power is a preponderating consideration? It follows from such reflections as these that there must be a good deal of the "wild cat" character about most British electricity-in-bulk projects. Electricity generation in bulk will come fast enough, as regards the practical engineering of it, with the growth of the demand for electric lighting in London and a handful of large towns, and with the tentative extension of electric traction above and below ground. It is putting the cart before the horse to do the generation in bulk first and then look round for trade in it. Parliament will be very chary indeed of granting statutory facilities for occupying a district on this pretence, unless the commercial prospects of the undertakers are pretty clear.

A great deal is said from time to time on the subject of the market for electric power in towns. Continuous current suppliers are always throwing their superior advantages in this regard at the heads of the alternating current men; and the latter dare not retort in the only effective way, by declaring that there is nothing in this branch worth quarrelling over. Everywhere companies and corporations supplying electricity for general purposes make a parade of the low charge at which they sell electricity for power; but it is rarely confessed that so little is used in this way that the business is not worth catering for. Yet it must be tolerably evident to everybody that the use of electric motors on town's mains does not increase very fast. There are several good reasons for this; but one not unimportant one was disclosed to the Electrical Power Bills Committee by Alderman Higginbottom, of Manchester. Answering a question of the Chairman, this witness said that the cost of working a 10-horse engine for 10 hours a day for 5 days a week for 50 weeks in the year, would be about £130 according to the Corporation scale of charging, which is $1\frac{1}{4}$d. per unit. This price is very low for electricity—probably below cost. Yet it may be remarked that a gas-engine of the same power, consuming Manchester gas at the increased price of 2s. 6d. per 1000 cubic feet, and at the rate of 25 cubic feet per horse power per hour, would only run up a gas-bill of £78 2s. 6d. for the same working year. It does not look from this comparison as if the electricians need trouble themselves over much about a general power connection where there is town's gas to be had at any price to be met with in England.

SIR H. H. FOWLER ON MUNICIPAL TRADING.

THE resumption of the sittings of the Joint Committee on Municipal Trading revives the interest of Sir Henry H. Fowler's masterly address on the subject, as President of the Royal Statistical Society, which we were only able to notice cursorily on the 29th ult. This address has now been published as a pamphlet, and should be in the possession of everybody who is in any way interested in the subject. It is hardly necessary to more than allude in passing to the desirability of applying the statistical method to the available facts of this matter. The expediency of extending the functions of municipal corporations and local authorities generally to include what are commonly regarded as trading enterprises—it is easier to understand what is meant by this classification than to strictly define it—has been accepted as axiomatic by a large and influential body of persons

interested in the work and the problems of local self-government. It is a view which is held in common by men of every shade of political opinion. As usual, there are extremists in this party of municipal expansion, as well as some whose levity in making the idea a cry for electioneering purposes tends to discredit the whole principle in the minds of serious people who regard the local self-government of communities as a trust, not a game, or a field for journalistic exploitation. Probably the majority of responsible municipal politicians regard the question of municipal trading as one of expediency, determinable with reference to the conditions of every particular case. The persistent endeavours of a few extremists, however, to overrule the question of expediency by erecting the universal desirability of the principle into an axiom, or an article of belief for those who pretend to belong to the Party of Progress and Light in municipal affairs, naturally arouses opposition. The opposition is necessarily directed to the question of principle. People are led to enquire what is the axiom to which they are asked to assent, and what is the justification for the dogma which is proposed as an article of Progressive belief, to be held over and above all considerations of particular instances. If the question is susceptible of a general answer, as the partisans of the principle contend, then the answer may be either yea or nay. Any amount of barren controversy on the abstract principle might be pursued to absolutely no purpose; because every particular example would after all have to be treated on the merits.

The worst of the hasty acceptance of the so-called principle of municipal trading is that, where the facts of any particular example do not support the presumption, there is a strong temptation, for those who have the opportunity, to manipulate the record and the accounts, so as to bring them into accord with their prejudices. It is notorious that the temptation has proved irresistible in many cases. If for this reason alone, Lord Avebury, and those who think with him on this matter, are resisting the attempt to put the municipalization of public works and services—some of which are trading enterprises—upon the ground of an accepted principle; and insist upon the sounder thesis that the prior and superior functions of municipalities are those of government, regulation, and the protection of their communities.

Sir H. Fowler comes forward at this juncture with a statistical presentment of how the local authorities of England and Wales actually stand financially, which is very much to the point of the practical issue of how much farther they should be permitted to pledge the rate funds of the country for all purposes. Following Mr. Goschen's report on local taxation of 1871, Sir H. Fowler shows that at the commencement of the century, and for the first forty years of it, this taxation consisted mainly of the poor, county, church, and highway rates. This list of the sources of local revenues is eloquent of the paucity of the services rendered by the local authorities. From 1841 to 1851, the police and borough rates were added; and during the third quarter of the century, the modern era of rating was initiated. For 1898, the amount of rates levied for all public purposes was £37,605,000; and there was an outstanding debt of £262,017,000. As much of this money represents property which is more or less remunerative, or in respect of which charges other than rates are made, it will be fairer to take the whole of the receipts of the local authorities, amounting to £69,144,000, as revenue corresponding to this capital indebtedness.

Large as this capital expenditure has been, it is classified by Sir H. Fowler as necessary and beneficial. So far from regarding it as excessive, he holds that it must and ought to be largely increased in the interests of the community as a whole. The next thing to be done, in order to test the application of this observation, is to divide the outstanding local debt under the various heads of necessary and obligatory, educational and recreative, and trading capital. Sir H. Fowler gives a mass of figures relating to the reproductive enterprises of municipal corporations. Although the returns are incomplete, he finds that a capital sum of £88,152,595 is represented in these undertakings. After ascertaining all the totals of the revenue accounts, he states as the practical result that "the income produced by the existing municipal enterprises pays the working expenses, the interest and instalments of the borrowed capital, and leaves a profit balance of £370,341, or about ½ per cent. on the outstanding debt."

Well, the natural reflection is, what of it? What meaning do his statistics convey to Sir H. Fowler's mind? Without more ado, having given the figures, he proceeds to observe that "the tendency of the present day is in the direction of combination, by which the public can secure greater advantages at a cheaper rate, and in a more efficient manner, than they could secure them by private enterprise; and there are beyond question certain public needs which ought to be supplied under the control of the local authorities." The difficulty arises as to where the line should be drawn between public enterprises carried on at the public risk, and private ventures supported by individual or joint-stock resources. The first kind of public supply or service undertakings that suggest themselves as an example in point is the railway system of a country; and the inquirer is confronted with the difference between English and Indian and Colonial practice in this regard. Parliament has decided in favour of the private ownership of English railways; and Sir H. Fowler thinks that on the whole no Government Department could beat the Railway Companies in respect to efficiency, safety, and speed. In other matters, as the supply of gas and water, Parliament has been eclectic. But the time has come when the partisans of extreme views on the desirability of municipal trading are trying to force Parliament to take their side. They ask for powers to engage in "banking, pawnbroking, coal supply, saddlery, manufacture of electrical fittings, of the residual products of gas, and other branches of trade and manufacture."

They ask why not? Cannot the local authority raise capital cheaply for general purposes; and should not the community have this and any other advantage of municipal as compared with private service? This contention is fairly met by Sir H. Fowler. The issue does not turn altogether upon the cheapness of municipal loans; and, besides, municipal money is not so cheap after all when the obligation of repayment is reckoned in. And the more a municipality engages in commercial pursuits, the closer will the interest payable on its mortgages approximate to the ordinary traders' rate. Then Sir H. Fowler does not admit that all the individual interest which has been so powerful an incentive to the attainment of the industrial successes of this country can be generally dispensed with, and the same results obtained by an uninterested public board operating through officials. Public bodies are necessarily less inclined to experiment, and more afraid of the scrap heap than are private firms. Their system of audit, moreover, is not satisfactory.

Sir H. Fowler is far from making light of the objection of private traders to municipal competition. He also agrees that the general consumer is not necessarily best served by a municipalized monopoly upon which, in the usual order of things, there is no check. "The essential principle of Free Trade is that the whole body of consumers are not to be taxed for the benefit of the producers; and while we have to carefully eliminate from our commercial system everything which infringes that principle, we must not allow it to be violated for the benefit of public authorities any more than for the benefit of private traders." Manchester gas, to wit!

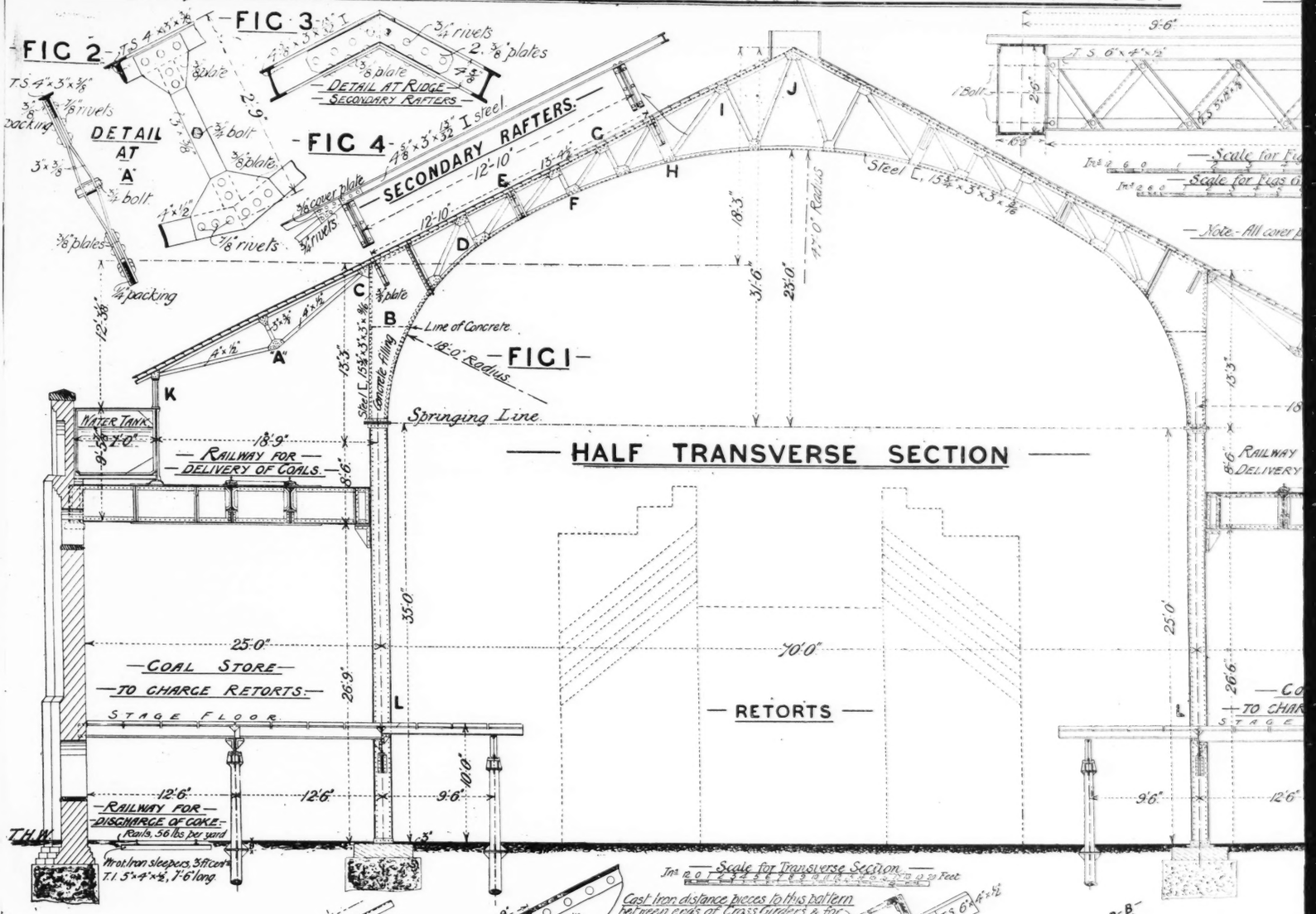
Lastly, Sir H. Fowler scouts the factitious clamour which pretends that the reference to the Joint Committee is an attack upon our municipal institutions. A municipal corporation is no fetish; but a means to an end. There are other agencies for doing those services to the community which are covered by the classification "municipal trading enterprises." If good and sufficient reasons exist, in places, for allowing the local authority to go into trade, some means must be found for ensuring that the original functions of the authority in regard to the particular trade—those of control and regulation in the public interest—are not neglected. Where the Lord Mayor goes behind the counter, somebody must wield the sword of Justice in his stead. As Sir H. Fowler more formally put it: "When municipal and local bodies are claiming wider powers, embracing new areas of commercial and industrial activity, questions arise not only as to the extent to which those powers should be granted, but also as to the regulations and checks by which they should be accompanied." This is a rebuke that the perfervid partisans of extreme municipalism have brought upon themselves. They must be told, if they do not realize, that there are limits to the field of municipal trading enterprise; and these boundaries are already in sight when the spirit of municipal monopolistic policy is found to be in conflict with the just interests of the ratepayers, the local tradesmen, and consumers. The true friends of municipal life and institutions, as Sir H. Fowler observes, are those who desire to see that life developed, and those institutions strengthened, on the broad basis of public benefit and of public support. They will not weaken the strength and value of municipal administration by extending it beyond its fair limits.

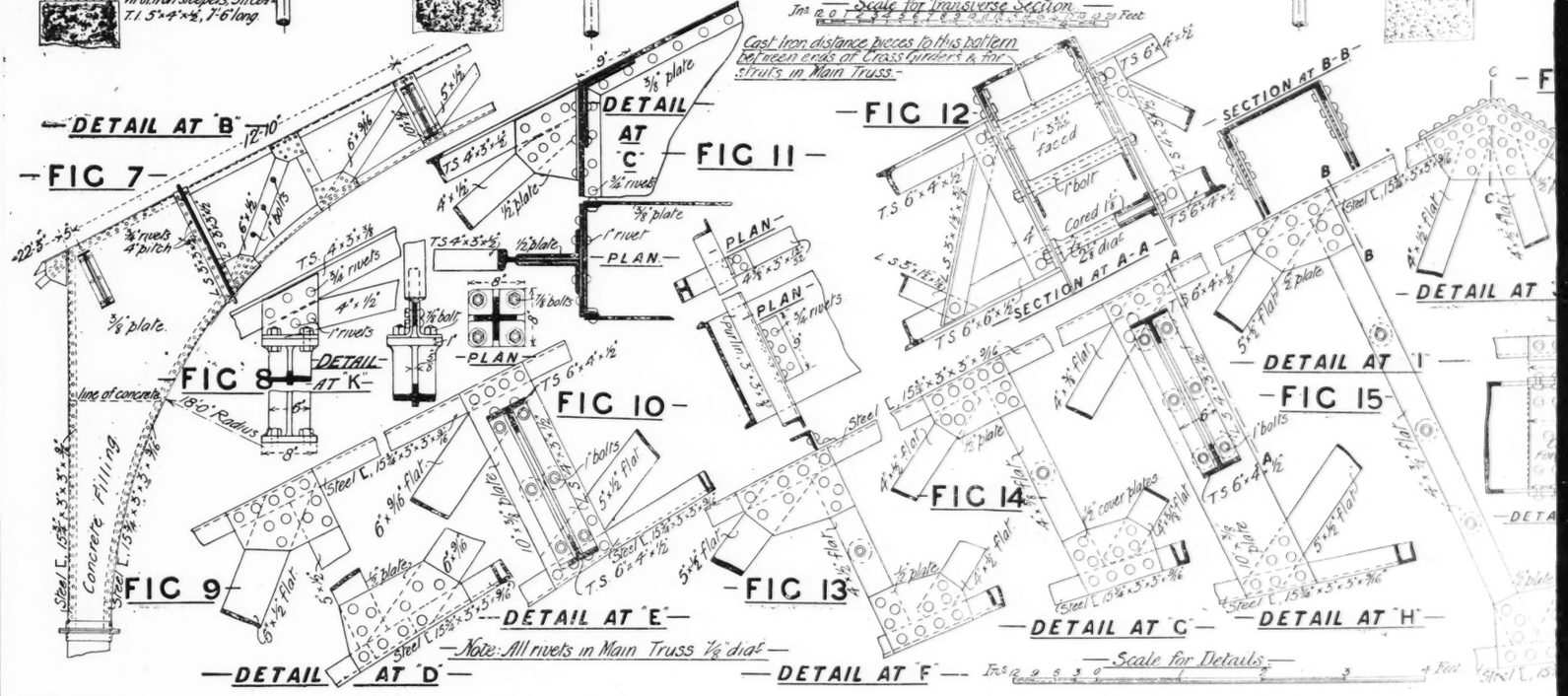
GAS UNDERTAKINGS AND THE SUPPLY OF ACETYLENE.

At the present time, when gas managers everywhere are striving to keep within reasonable bounds all capital expenditure, and when they are perforce obliged to look for an immediate return on all outlays and expenses, some particulars of a scheme recently suggested by the Acetylene Illuminating Company, Limited, may be of interest. As our readers are aware, the Company are manufacturers of carbide of calcium on a large scale; their experience in the matter dating back as far as August, 1894. They were the first in Europe to erect electrical furnaces for the commercial manufacture of carbide, and to introduce lighting by acetylene, which has since made such progress that it is reported that at least 100,000-horse power are now being used throughout the world for making carbide, whereas there were not 100-horse power employed when the Company started operations.

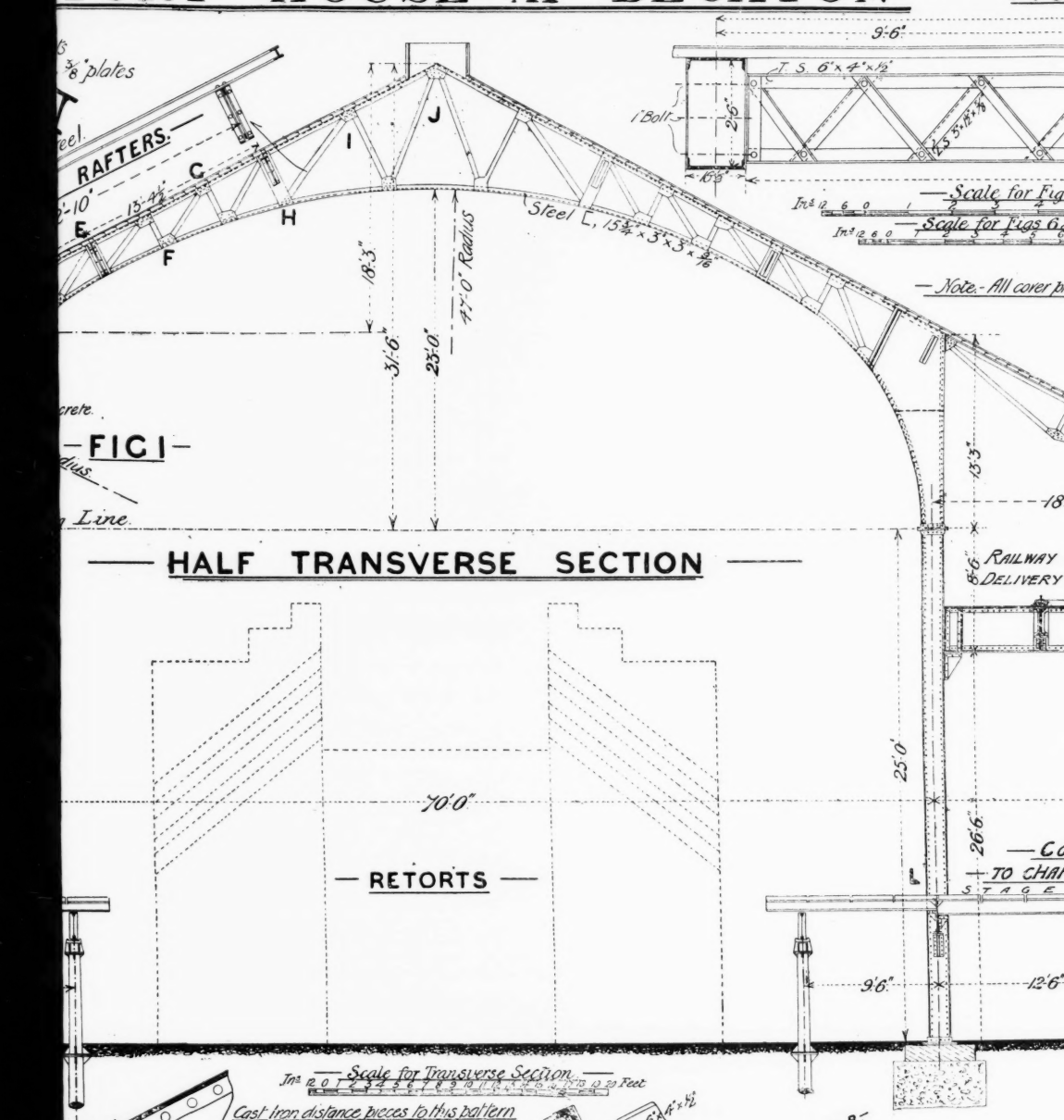
The general feature of the Company's proposal is that, in outlying portions of their districts, where an extension of coal-gas mains is at the present time impracticable, gas managers should recommend the use of acetylene plant, so as to secure a permanent source of profit, though at the same time without incurring the need for any capital expenditure. To carry out this idea, the Company announce that they are prepared to generate acetylene from central stations for the lighting of large villages, hamlets, and groups of private houses (charging by meter for the gas consumed), or to arrange detached installations for single houses, as may be most convenient. In thus extending their operations, they are wishful to act in concert with the gas supplying authority—furnishing everything for a

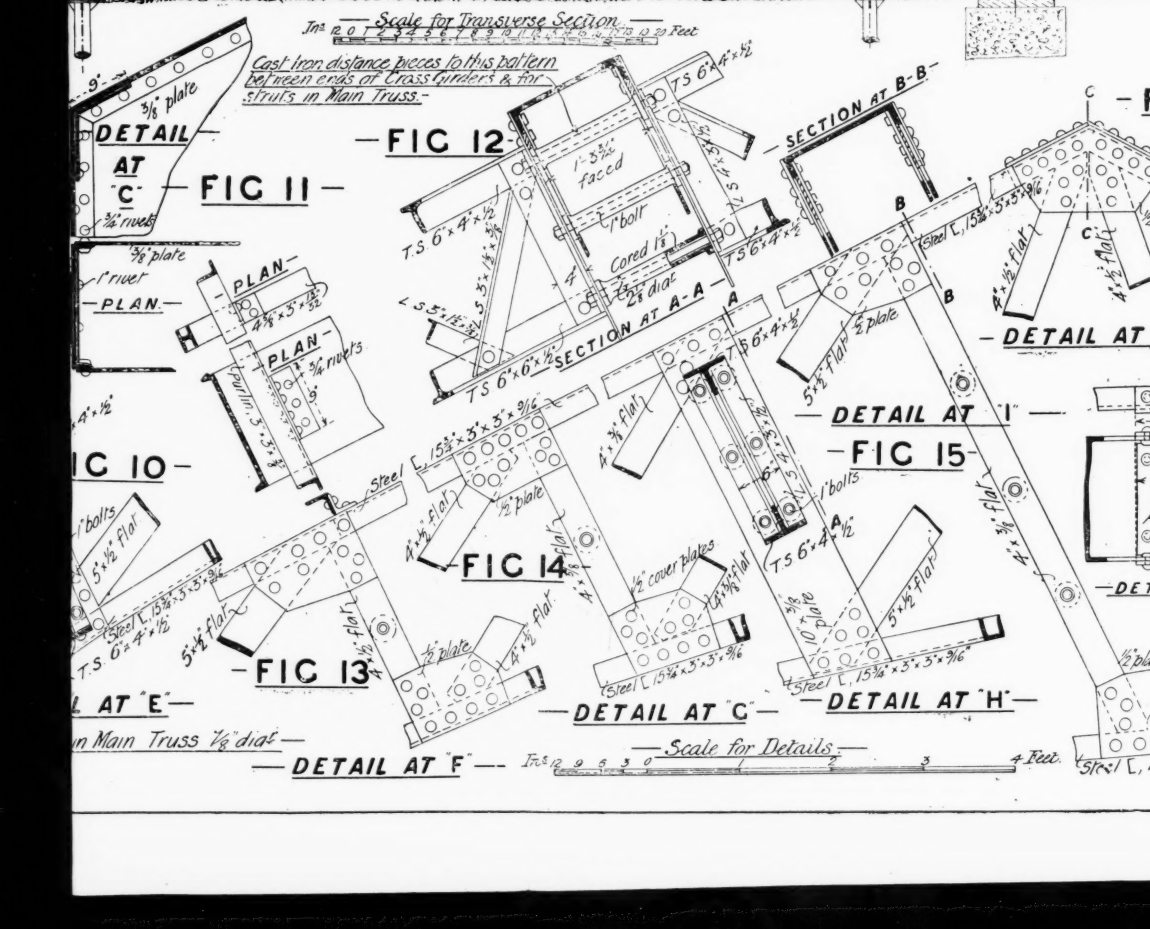
ROOF OVER RETORT HOUSE AT BECKTON

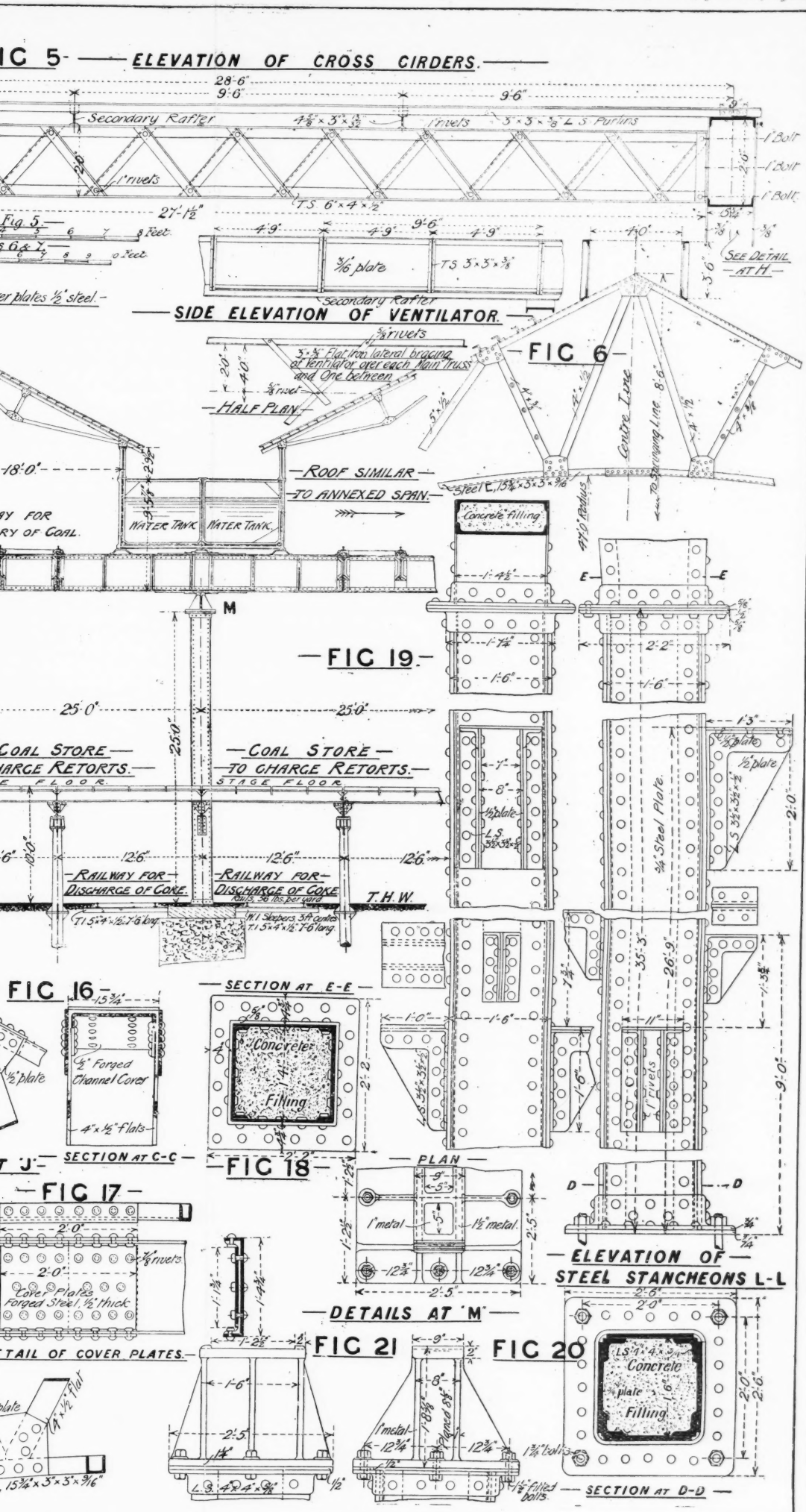




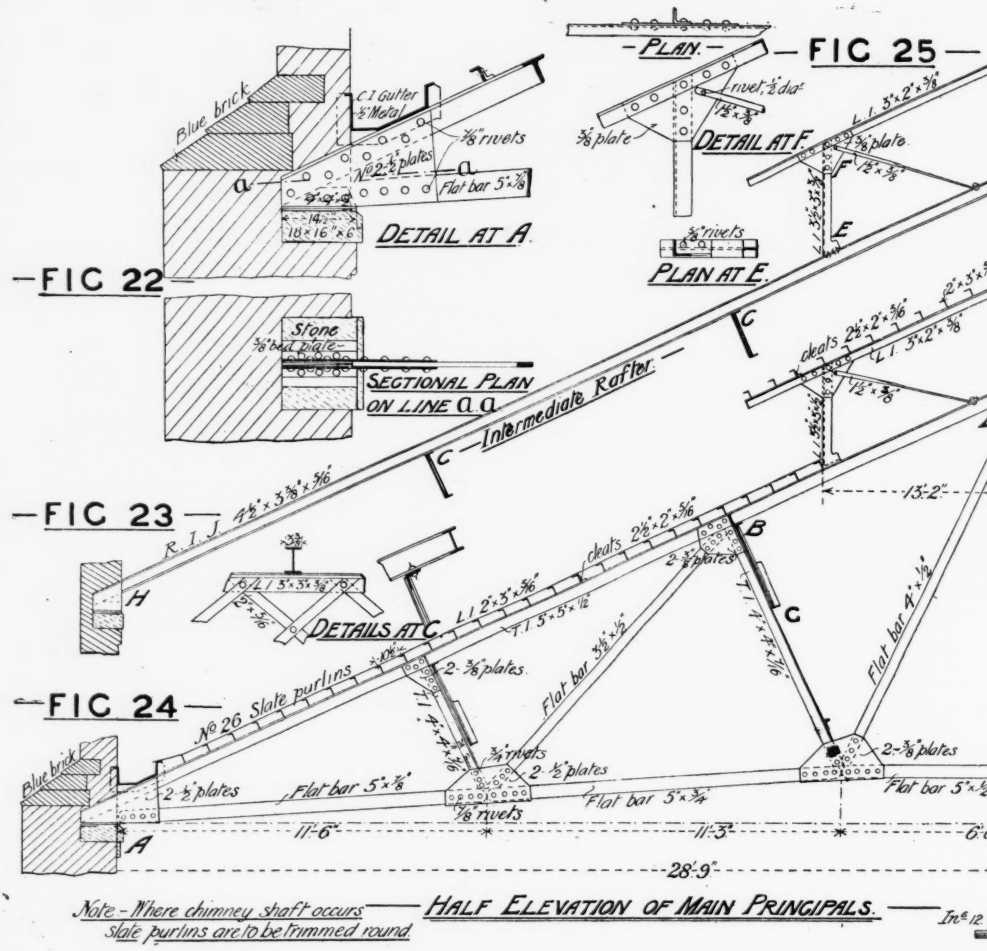
TORT HOUSE AT BECKTON — FIG



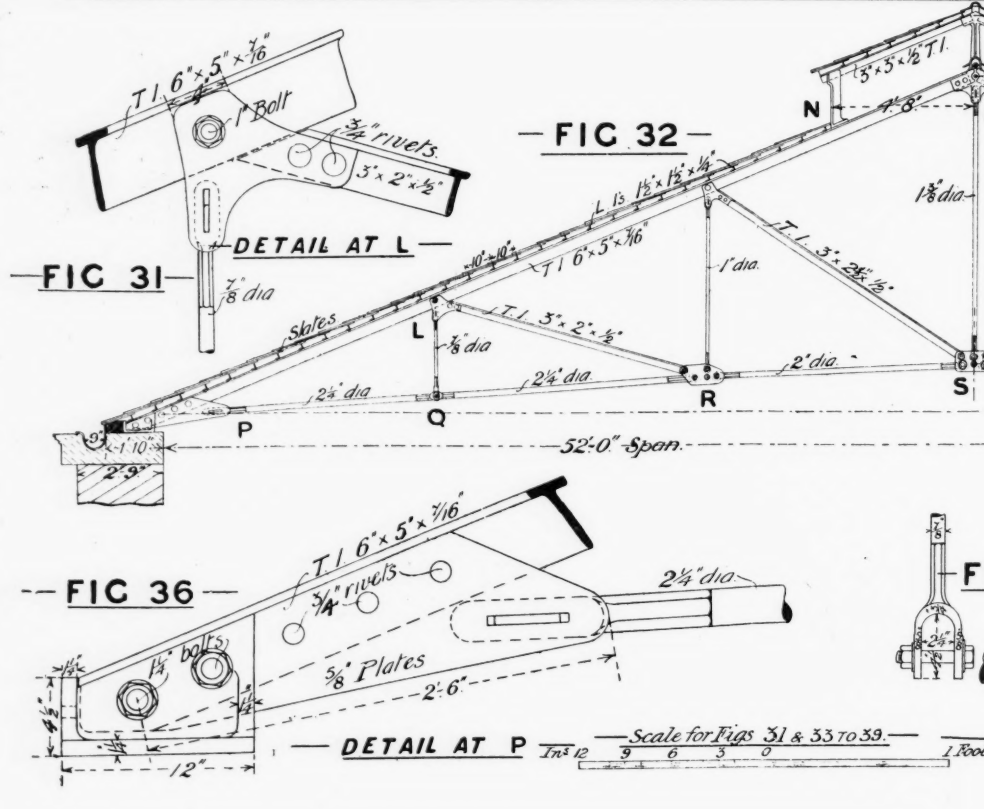



IC 5 — ELEVATION OF CROSS GIRDERS.
28'-6"
9'-6"
9'-6"
Secondary Rafter
4⅝" × 3" × ⅜"
Rivets
3" × 3" × ⅜" L S Purlins
1" Bolt
1" Bolt
1" Bolt
2'-0"
1" Rivets
TS 6" × 4" × ½"
27'-1½"
Fig 5
4'-9"
4'-9"
9'-6"
4'-9"
4'-0"
⅜" plate
TS 3" × 3" × ⅜"
SEE DETAIL AT H
Secondary Rafter
er plates ½" steel.
SIDE ELEVATION OF VENTILATOR.
⅝" Rivets
3" × ⅜" Flat iron lateral bracing at Ventilator over each Main Truss and One between
20'
40'
⅝" rivet
HALF PLAN.
FIG 6
Centre Line
8'-6"
4" × ½"
4" × ½"
4" × ⅜"
4" × ⅜"
5" × ½"
Steel L, 15¾" × 3" × 3" × ⅜"
To Opposite Line
47'-0" Radius
ROOF SIMILAR TO ANNEXED SPAN.
18'-0"
2½"
3'-3"
WATER TANK
WATER TANK
Y FOR
RY OF COAL.
Concrete filling
1'-4½"
1'-7¼"
1'-6"
E
E
2'-2"
1'-6"
M
FIG 19.
25'-0"
25'-0"
25'0"
COAL STORE — HARGE RETORTS.
STAGE FLOOR
— COAL STORE — TO CHARGE RETORTS.
STAGE FLOOR
12'6"
12'6"
12'6"
RAILWAY FOR DISCHARGE OF COKE.
RAILWAY FOR DISCHARGE OF COKE
T.H.W.
T1 5"×4"×½" T 6" long
W1 Stephens 3 ft centres T1 5"×4"×½" T 6" long
1'3"
½" plate
½" plate
2'0"
¾" Steel Plate.
L S 3½"×3½"×½"
1'-7"
8"
½" plate
L S 3½"×3½"×½"
FIG 16.
15¾"
½" plate
½" Forged Channel Cover
4" × ½" Flats
SECTION AT C-C
SECTION AT E-E
⅝"
4"
Concrete Filling
4"
2'-2"
2'-2"
FIG 18.
1'-0"
1'-6"
L S 3½"×3½"×½"
35'-3"
26'-9"
1'-3½"
11"
1" rivets
1'-6"
9'-0"
PLAN
9"
5"
5"
1'-2½"
1" metal.
1½" metal.
12¾"
12¾"
2'-5"
2'-5"
D
D
¾"
7¼"
ELEVATION OF STEEL STANCHEONS L-L
FIG 17.
2'-0"
⅞" rivets
2'-0"
Cover Plates Forged Steel, ½" thick
TAIL OF COVER PLATES.
DETAILS AT 'M'
1'-1¾"
1'-4¾"
1'-2½"
½"
FIG 21
FIG 20
1'-6"
2'-5"
¼"
L S 4"×4"×⅝"
½"
9"
2"
8"
1" metal
12¾"
12¾"
Planed 8¾"
1¾" bolts
1¾" fitted bolts
2'-6"
2'-0"
L S 4" × 3" × ½"
Concrete
plate
Filling
1'-6"
2'-0"
2'-6"
SECTION AT D-D
½" Flat
15¾" × 3" × 3" × 3/16"

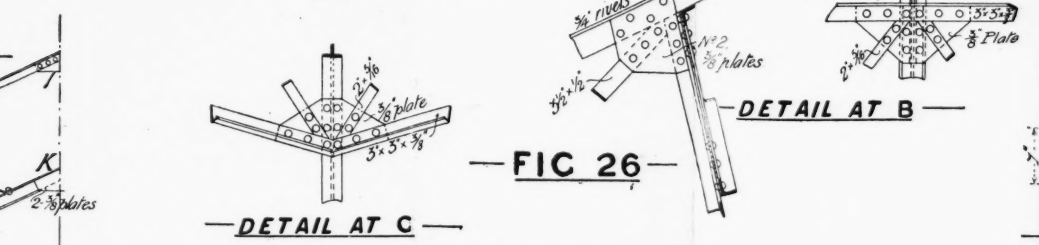
ROOF OVER RETORT HOUSE



ROOF OVER RETORT HOUSE AT DERI



E AT BOW COMMON.



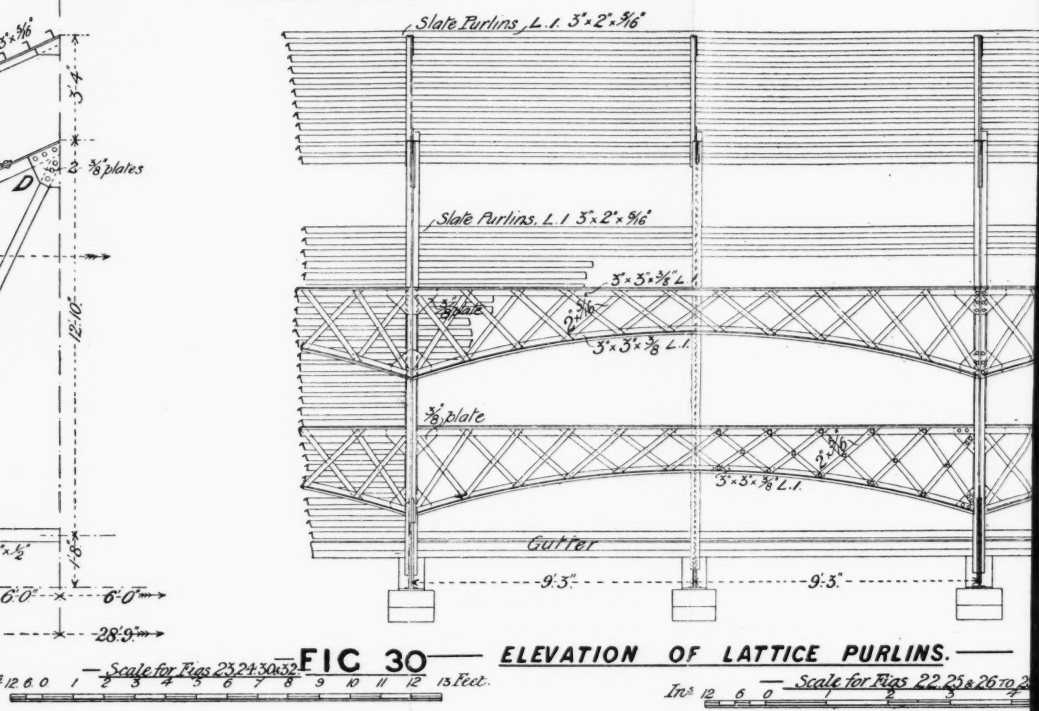
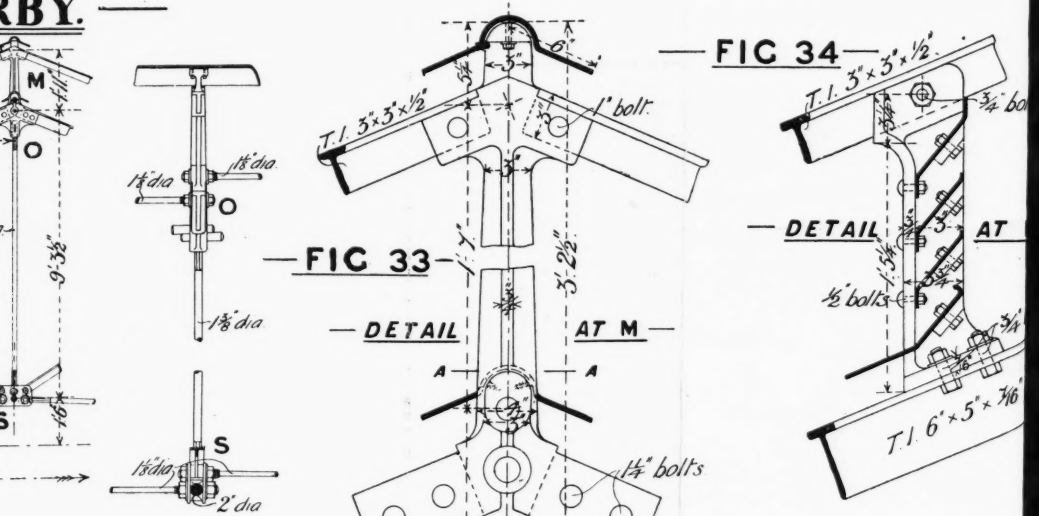
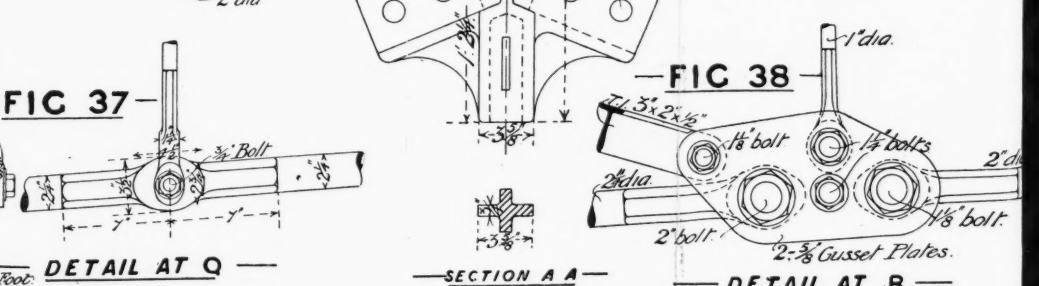


FIG 30 — ELEVATION OF LATTICE PURLINS.

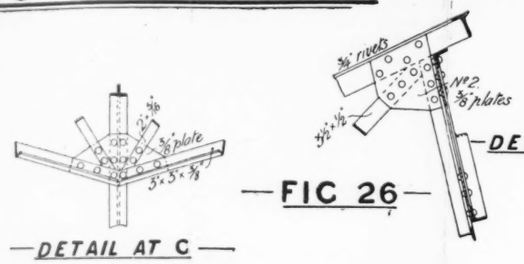
Scale for Figs 23,24,30,32 — Scale for Figs 22,25 & 26 to 2

RBY.





AT BOW COMMON.



DETAIL AT B

FIG 26

DETAIL AT C

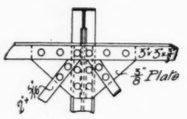
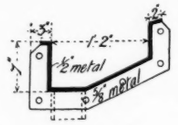
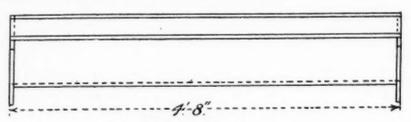


FIG 27

DETAILS OF CUTTER



SECTION



ELEVATION

Scale for Fig 1 — Inches 12 9 6 3 0 — 2 Feet.

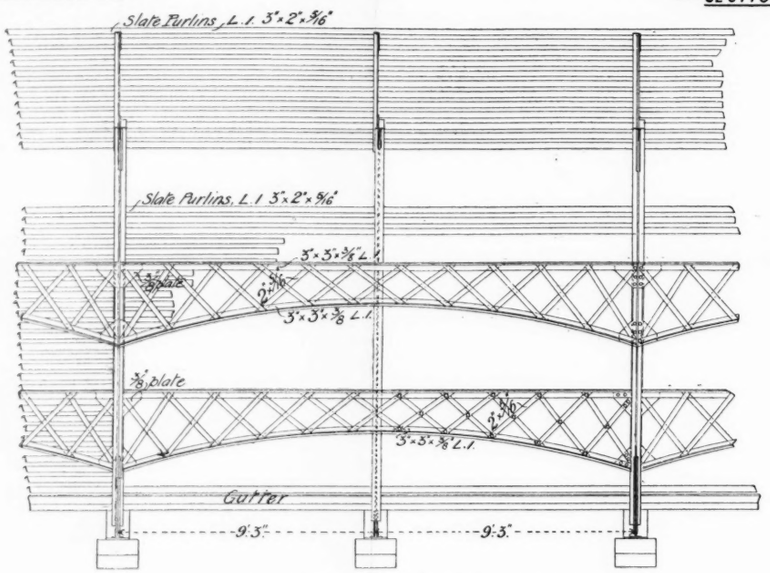
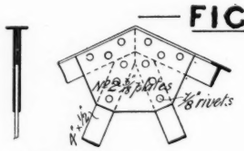


FIG 28

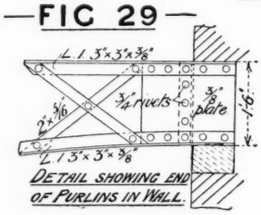


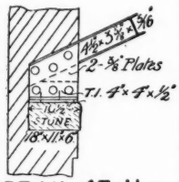
DETAIL AT D

DETAIL AT I

DETAIL AT K

FIG 29





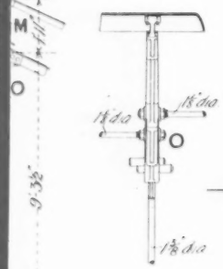
DETAIL AT H

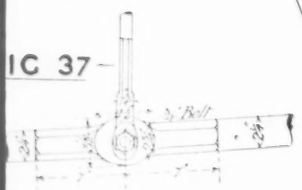
FIG 30 — ELEVATION OF LATTICE PURLINS.

Scale for Figs 23,24,30&32 — 0 1 2 3 4 5 6 7 8 9 10 11 12 13 Feet.

Scale for Figs 22,25&26 to 29 — Ins 12 6 0 — 5 6 Feet.

BY.





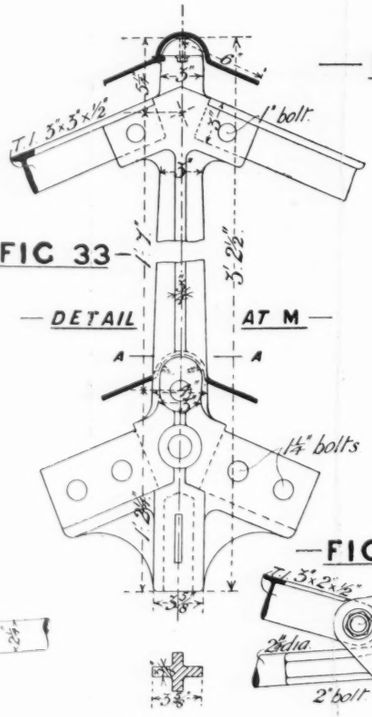
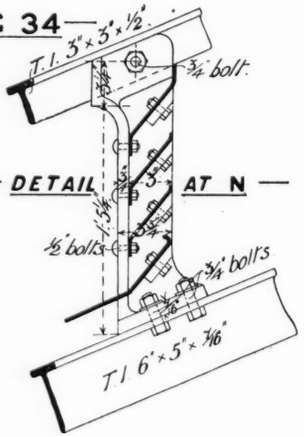


FIG 33

DETAIL AT M

FIG 34



DETAIL AT N

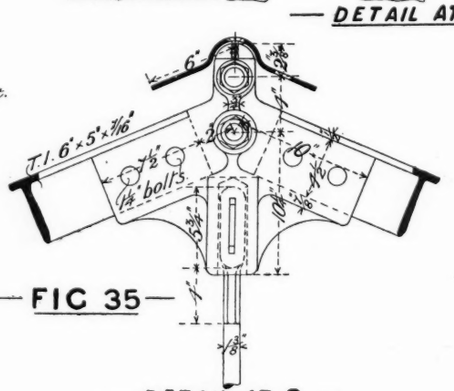


FIG 35

DETAIL AT O

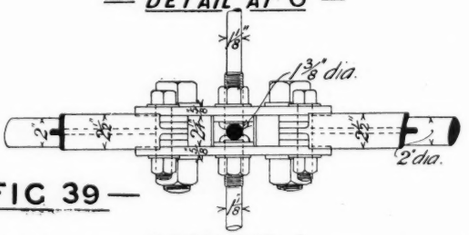
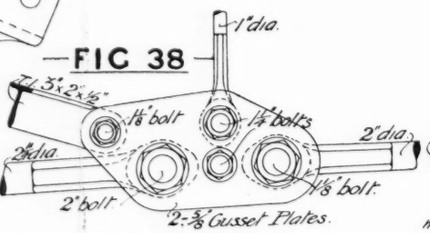
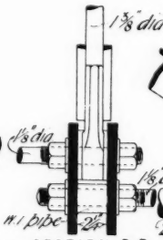


FIG 39

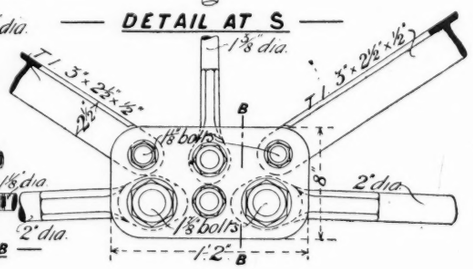
DETAIL AT S



DETAIL AT R

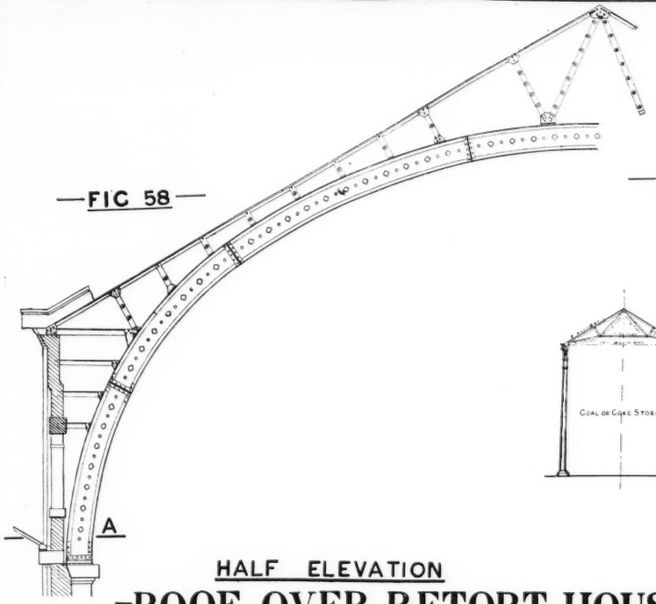


SECTION B-B



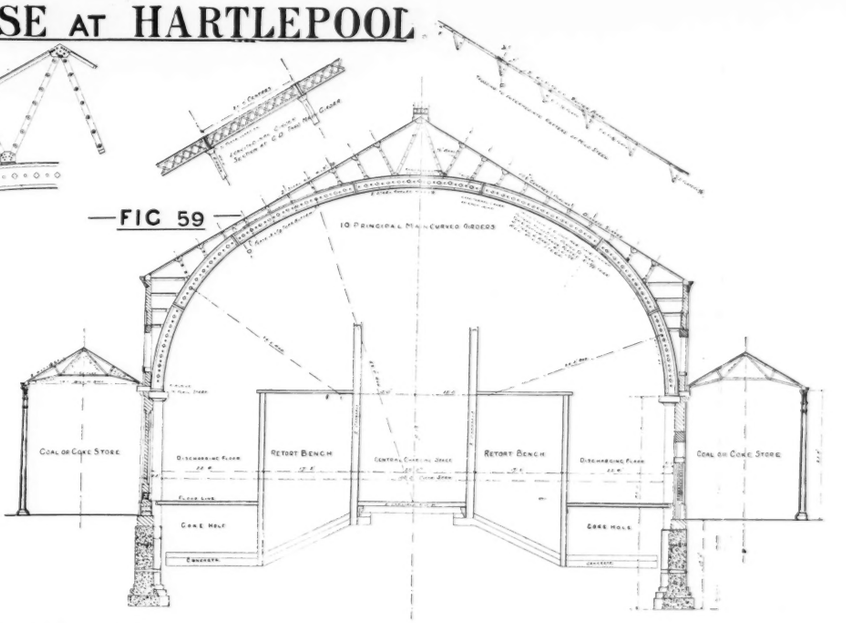
ROOF OVER RETORT HOUSE AT HARTLEPOOL

—FIG 58—



HALF ELEVATION

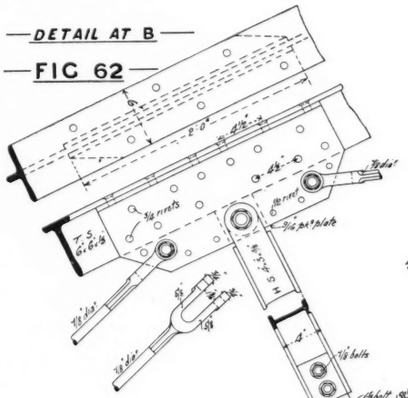
—FIG 59—



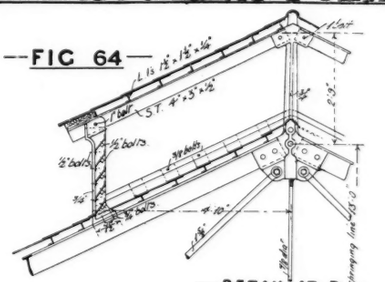
ROOF OVER RETORT HOUSE AT FOLKESTONE

—DETAIL AT B—

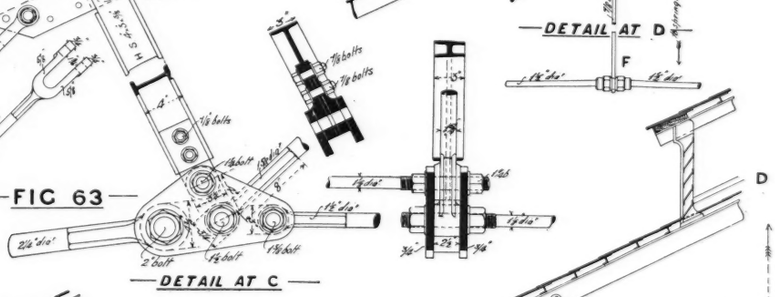
—FIG 62—



—FIG 64—

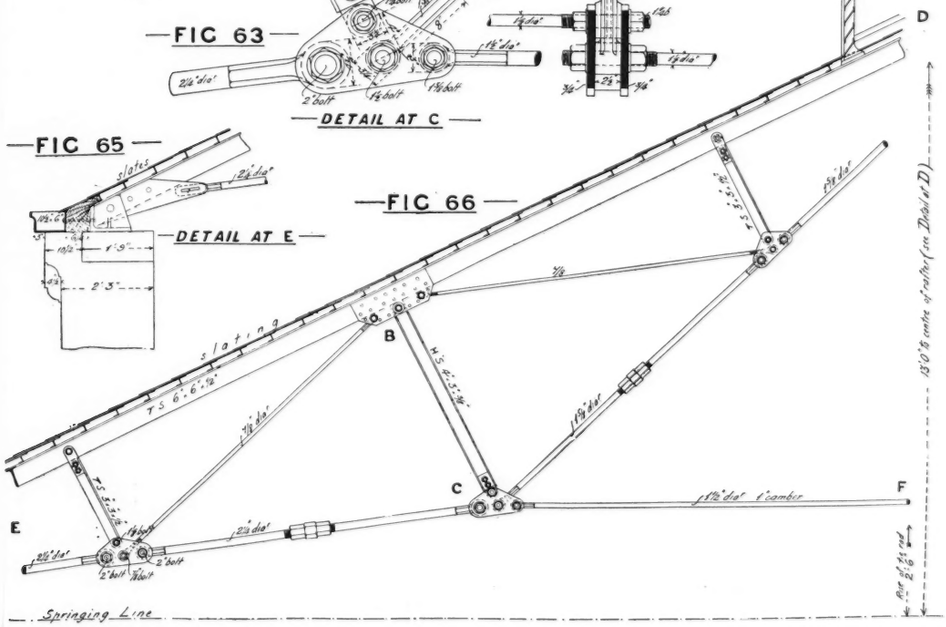


—FIG 63—



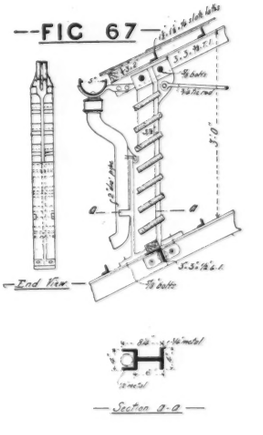
—FIG 65—

—FIG 66—

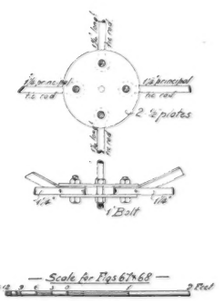


ROOF OVER PURIFYING HOUSE AT CRIMESTHORPE

—FIG 67—

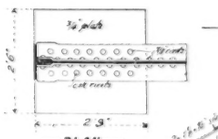


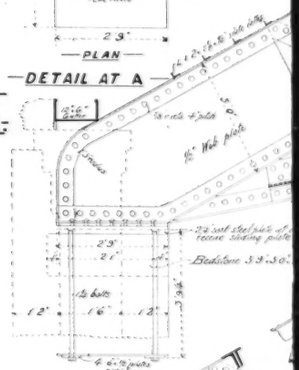
—FIG 68—

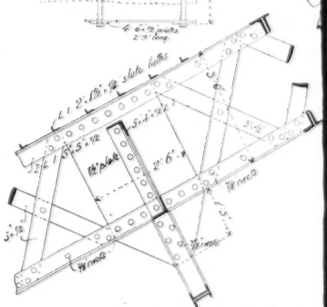


ROOF OVER RE

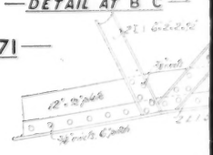
—FIG



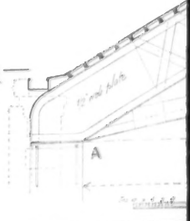




—FIG 71—

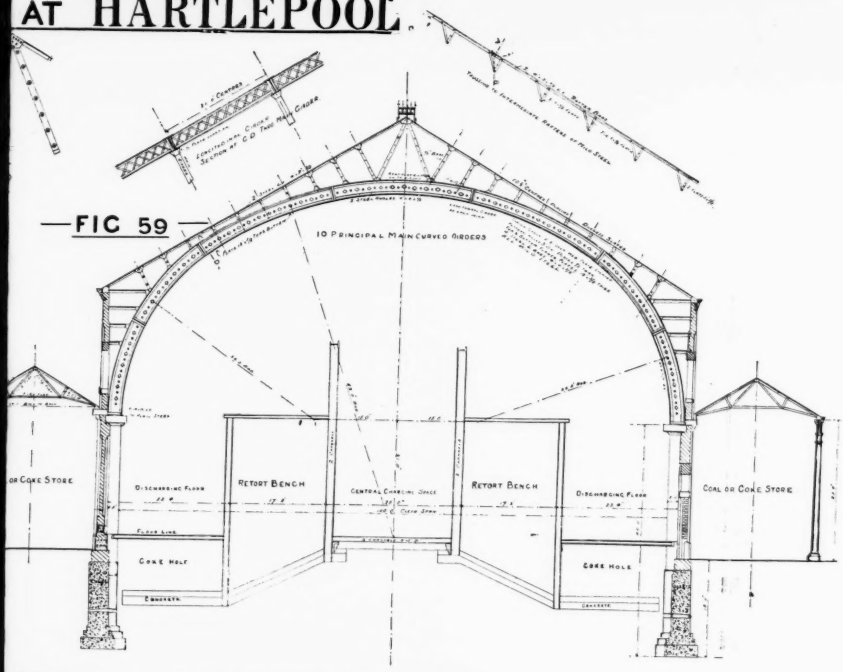


—FIG 73—



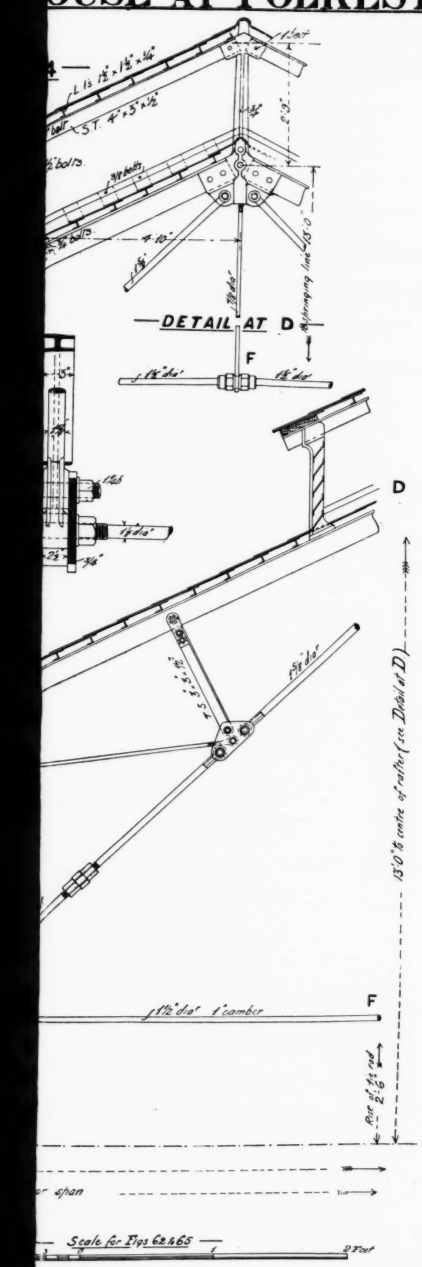
AT HARTLEPOOL.

—FIG 59—



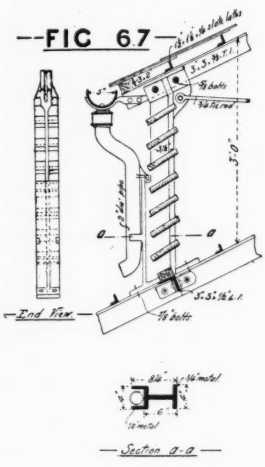
—R

OUSE AT FOLKESTONE.—

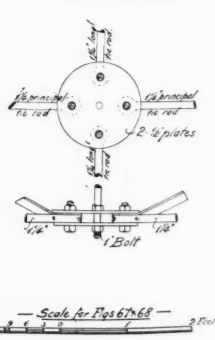


—ROOF OVER PURIFYING—
—HOUSE AT CRIMESTHORPE.—

—FIG 67—

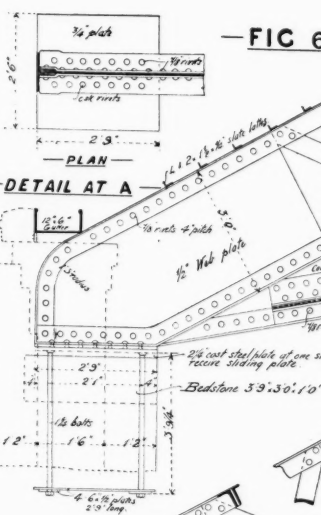


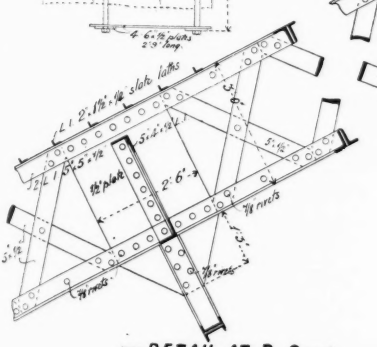
—FIG 68—



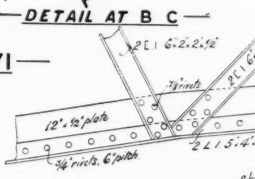
ROOF OVER RETO

—FIG 6

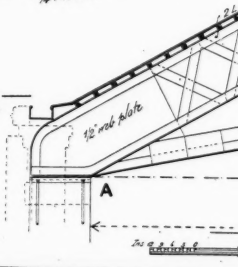




—FIG 71—



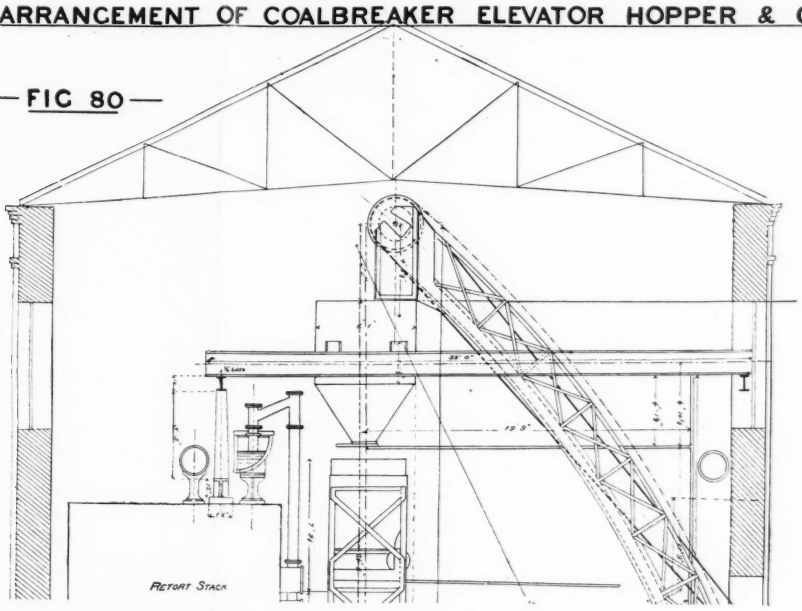
—FIG 73—



RAMSCATE CORPORATION CAS WORKS.—

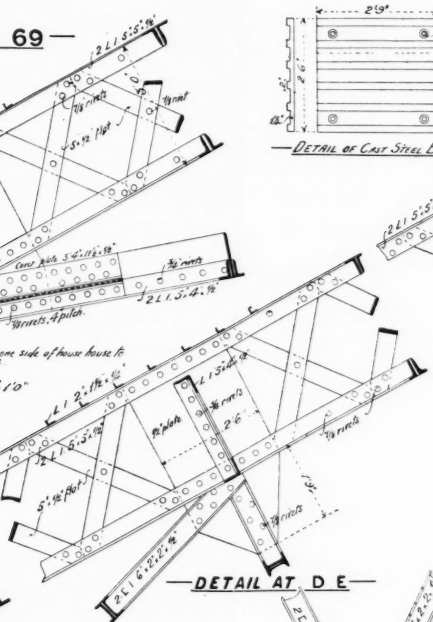
—ARRANGEMENT OF COALBREAKER ELEVATOR HOPPER & CIRDERS.—

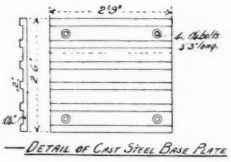
—FIC 80—



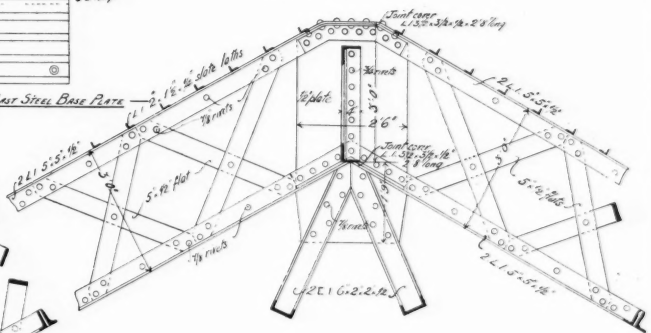
TORT HOUSE AT NEWCASTLE.—

—69—





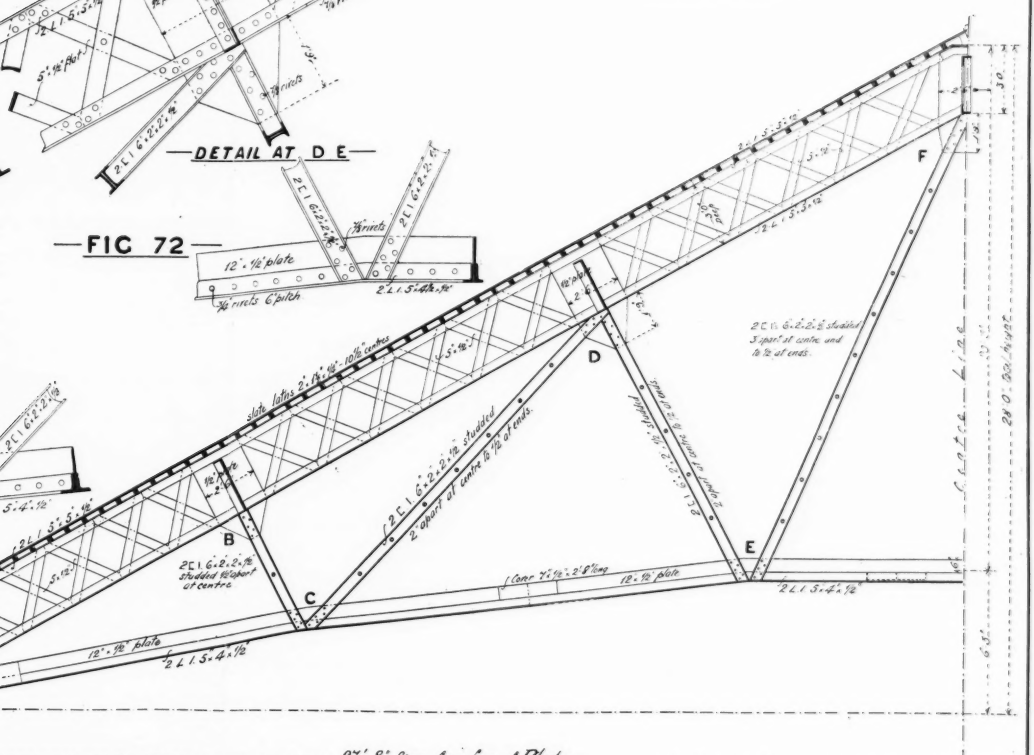
—FIC 70—



—DETAIL AT F—

—DETAIL AT D E—

—FIC 72—


F
D
E
B
C
2 C I 6·2·2·⅝ studded 3 apart at centre and 6 at ends.
2 C I 6·2·2·½ studded 2 apart at centre & 6 at ends.
2 C I 6·2·2·⅝ studded 6 apart at centre.
12"·½" plate
2 L I 5·4·½
Scale for Figs 69 to 72
97'-8" Span from face of Pilaster
Scale for Fig 73.

ROOF OVER RETORT HOUSE AT GRIMESTHORPE.

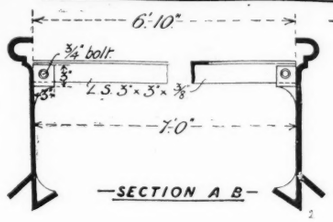
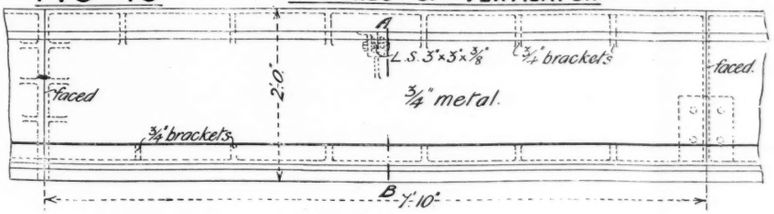


FIG 40 — DETAILS OF VENTILATOR



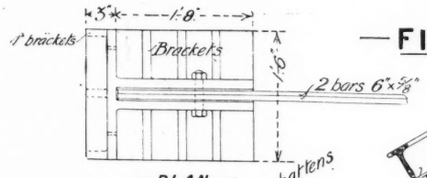
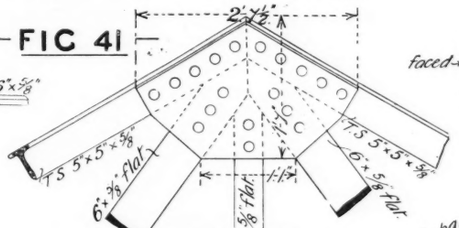
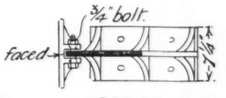


FIG 41





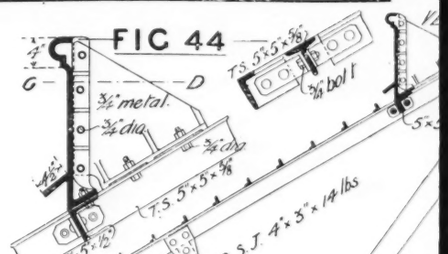
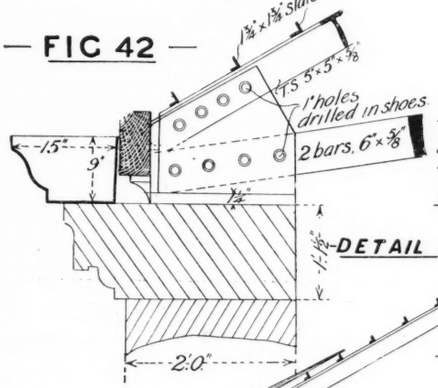
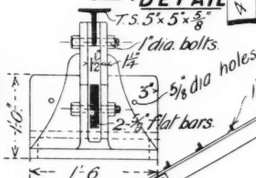


FIG 42



DETAIL AT H



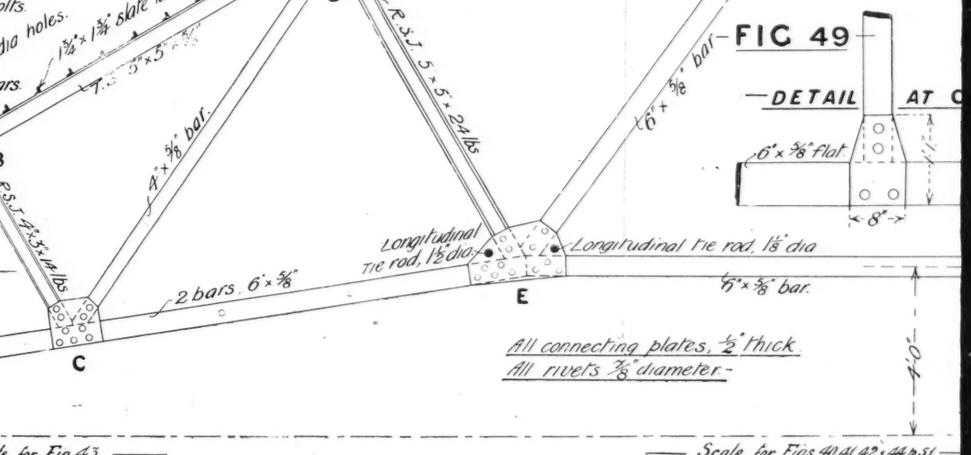
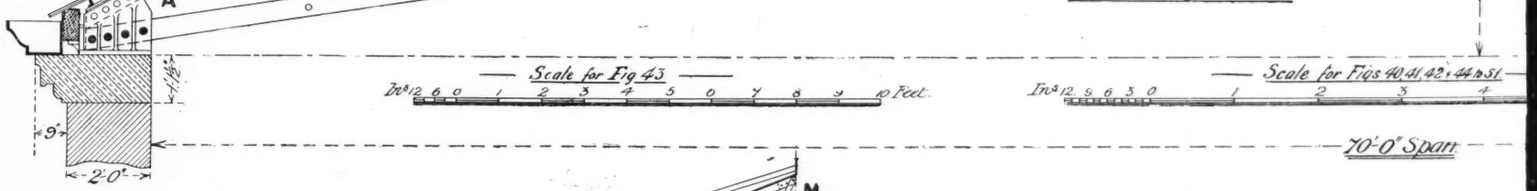


FIG 49

FIG 43



ROOF OVER PASSENGER STATION AT SITTINGBOURNE.

FIG 52

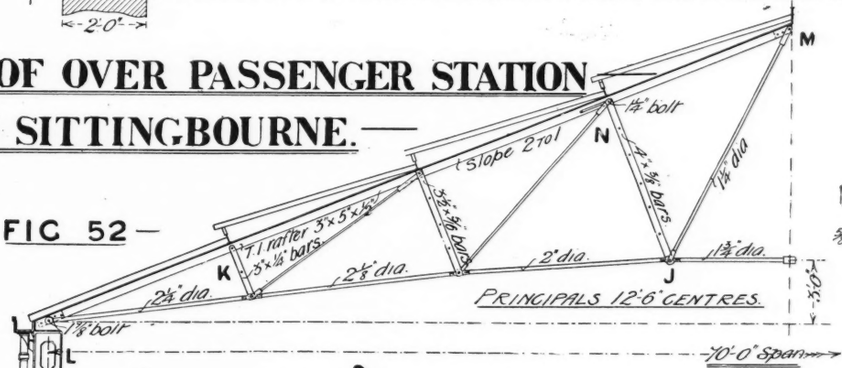


FIG 55

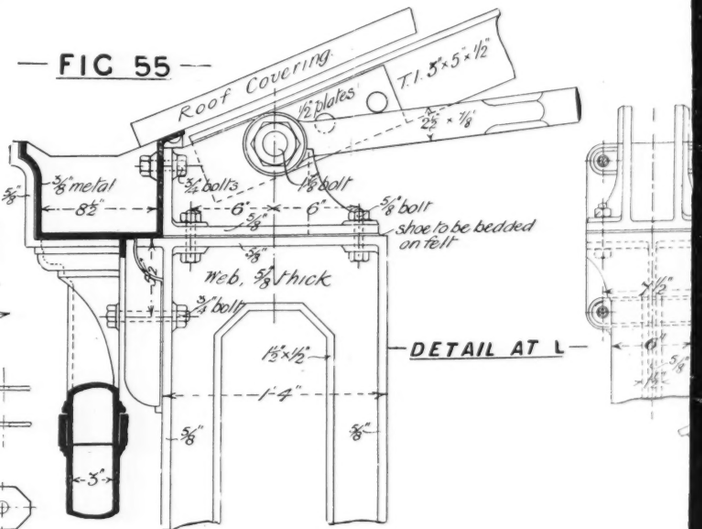


FIG 53

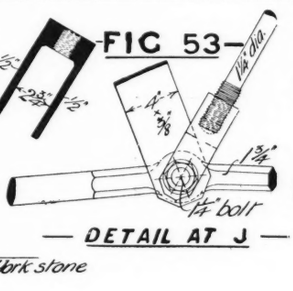
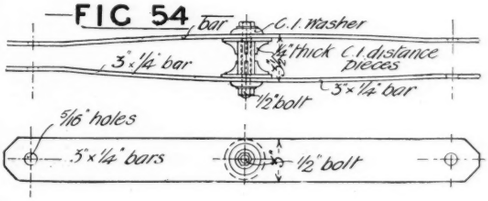
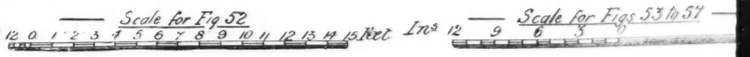


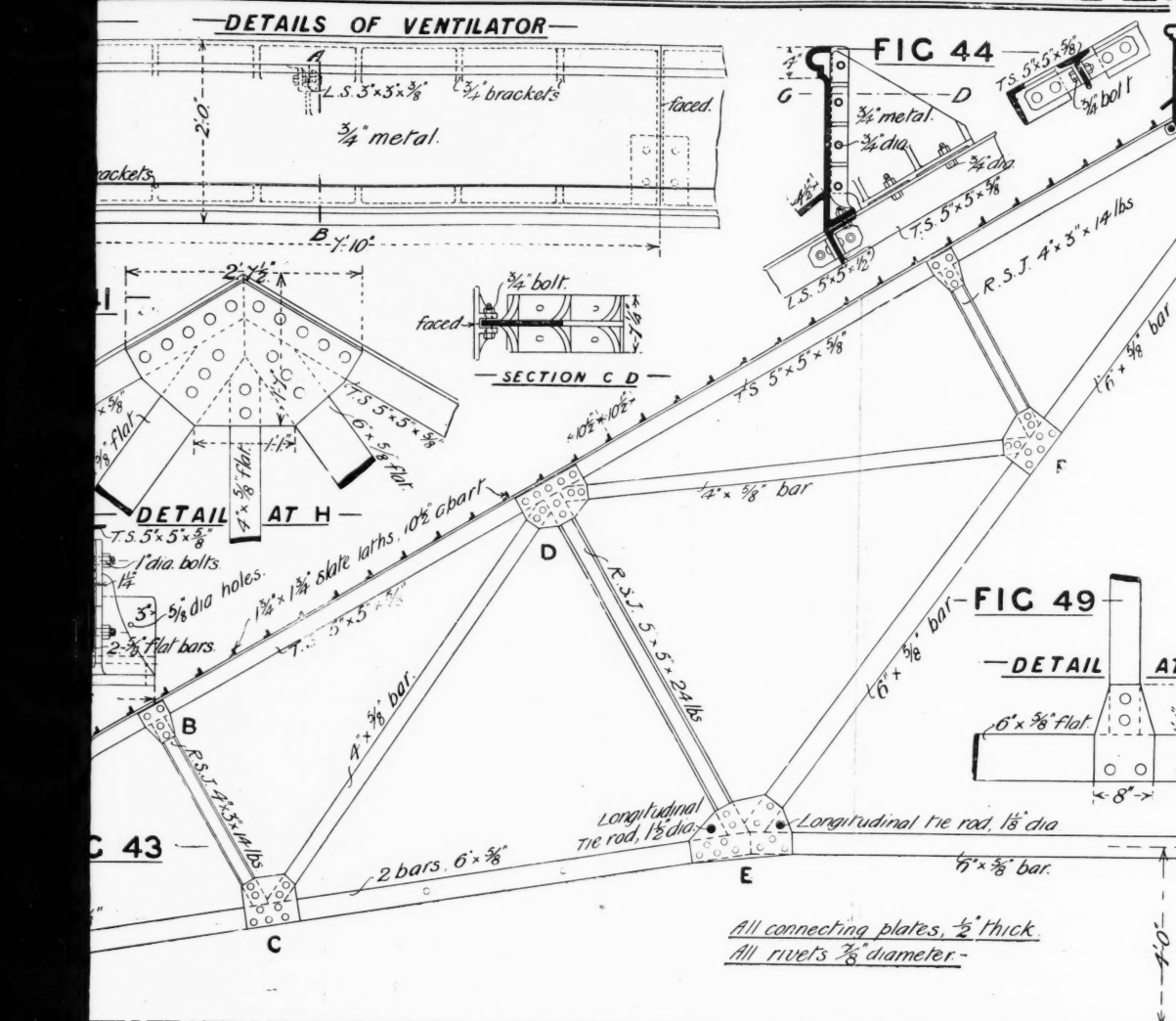
FIG 54

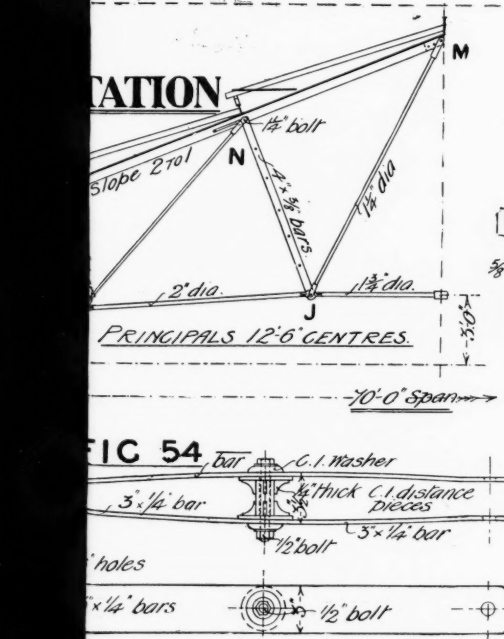


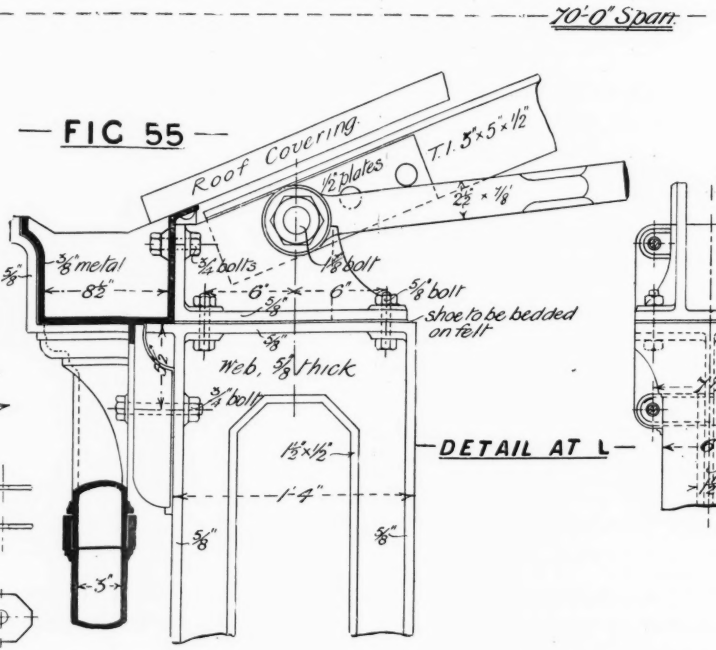
DETAIL AT K

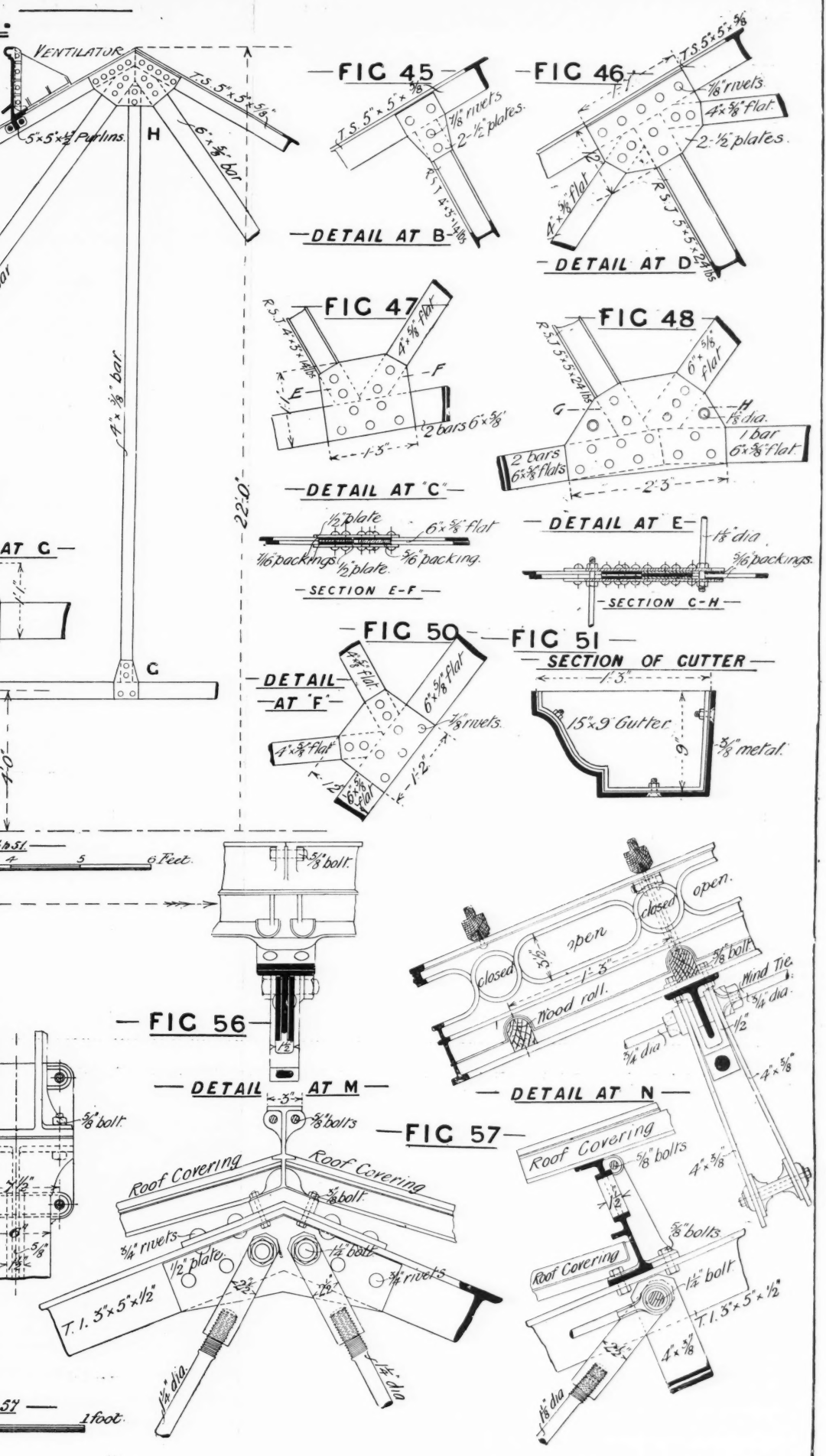


TORT HOUSE AT GRIMESTHORPE.



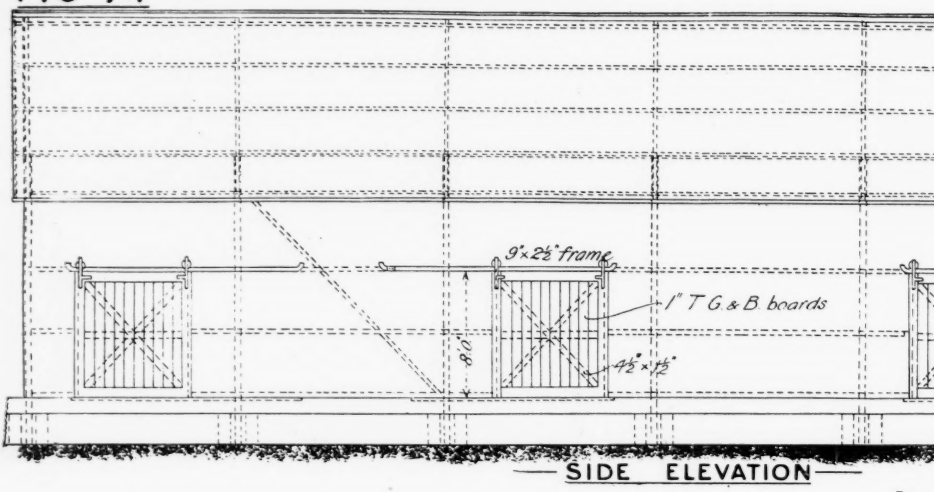





VENTILATOR
T.S. 5"×5"×5/8"
5"×5"×½" Purlins.
H
6"×⅜" bar
4"×⅜" bar
C
22'0"
AT C
FIG 45
T.S. 5"×5"×⅜
⅞" rivets
2-½" plates
DETAIL AT B
FIG 46
T.S. 5"×5"×⅝
⅞" rivets
4"×⅝" flat
2-½" plates
4"×⅜" flat
R 3 J 5"×5"×24 lbs
DETAIL AT D
FIG 47
R.S.J. 4"×3"×14 lbs
4"×⅜" flat
F
E
2 bars 6"×⅜"
1'-3"
DETAIL AT "C"
FIG 48
R.S.J. 5"×5"×24 lbs
6"×⅝" flat
G
H
⅞" dia.
1 bar 6"×⅜" flat
2 bars 6"×⅜" flats
2'-3"
½" plate
6"×⅜" flat
1/16" packings
½" plate
5/16" packing
SECTION E-F
DETAIL AT E
⅞" dia.
5/16" packings
SECTION C-H
FIG 50
4"×⅜" flat
DETAIL AT "F"
6"×⅝" flat
⅞" rivets
4"×⅝" flat
1'-2"
6"×⅝" flat
FIG 51
SECTION OF CUTTER
1'-3"
15"×9" Gutter
6"
⅝" metal
4 5 6 Feet
⅝" bolt
FIG 56
DETAIL AT M
3"
⅝" bolts
⅝" bolt
Roof Covering
Roof Covering
¾" rivets
½" plate
T. I. 3"×5"×½"
½" bolt
¾" rivets
2½"
2½"
1¼" dia
1¼" dia
1 foot
closed
open
closed
open
2'-2"
1'-3"
⅝" bolt
Wood roll
Wind Tie
¾" dia
½"
¾" dia
4"×⅝"
FIG 57
DETAIL AT N
Roof Covering
⅝" bolts
4"×⅜"
½"
⅝" bolts
Roof Covering
1¼" bolt
T. I. 3"×5"×½"
2½"
4"×⅜"
1⅛" dia

CORRUGATED IRON ROOF o

FIG 74

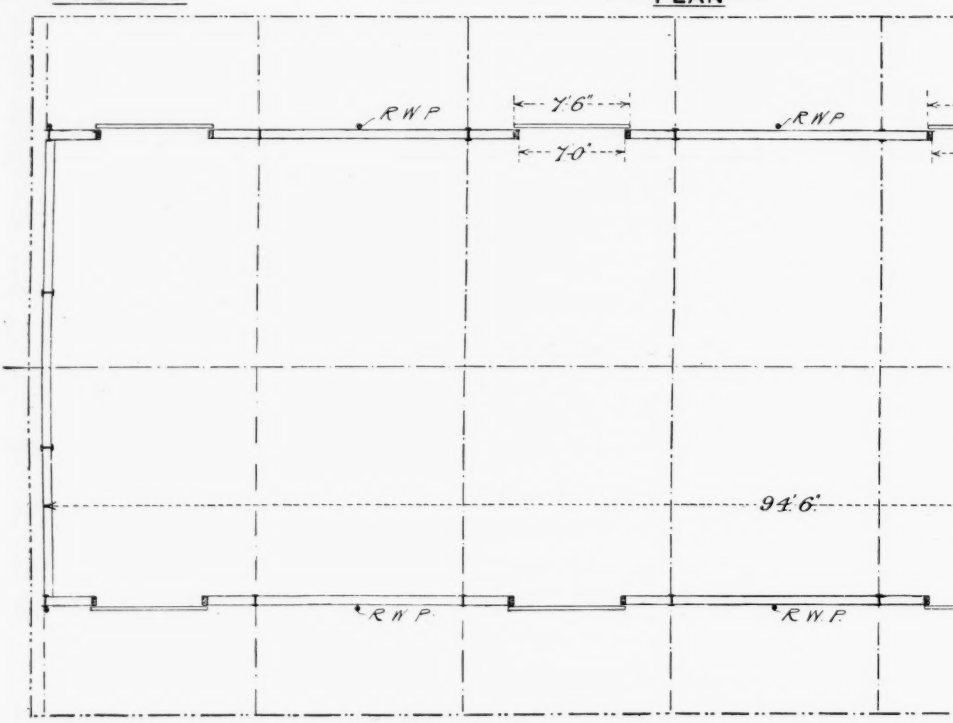


SIDE ELEVATION

Ins 12

FIG 75

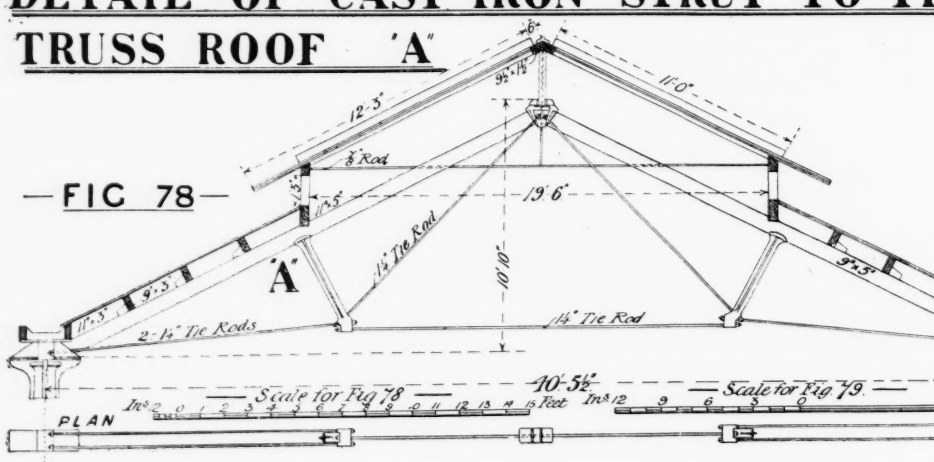
PLAN



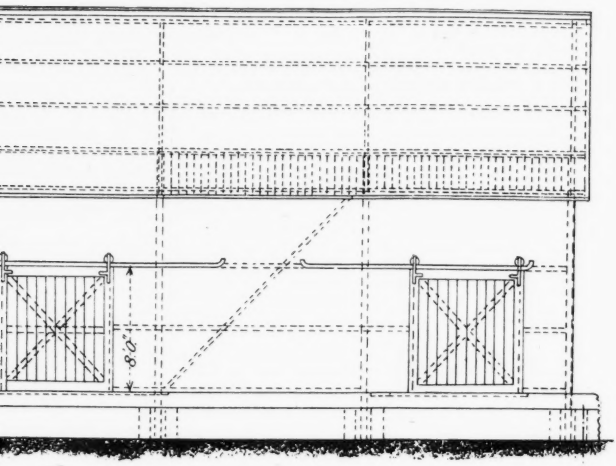
DETAIL OF CAST IRON STRUT TO TI

TRUSS ROOF 'A'

FIG 78

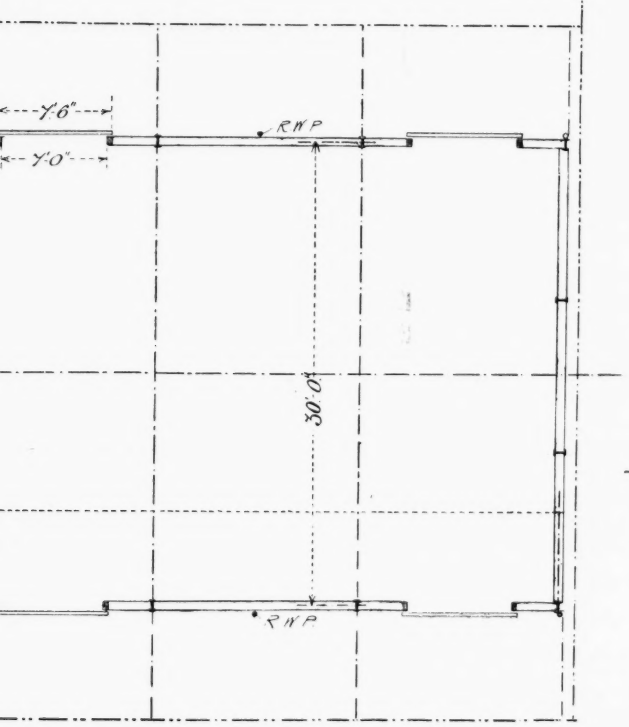


OVER STORES. 94'-6" × 30'-0"



Scale for Figs 74 & 75

0 1 2 3 4 5 10 15 20 25 30 Feet



Timber framing secured to joists with 3" × 2" × 5/16" L. cleats - All bolts to be 5/8" dia. except where shown otherwise.

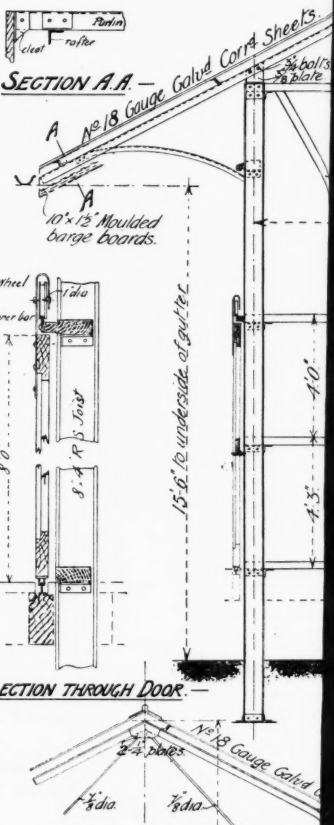
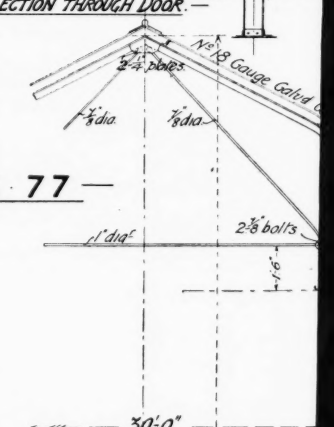


FIG 77



TIMBER

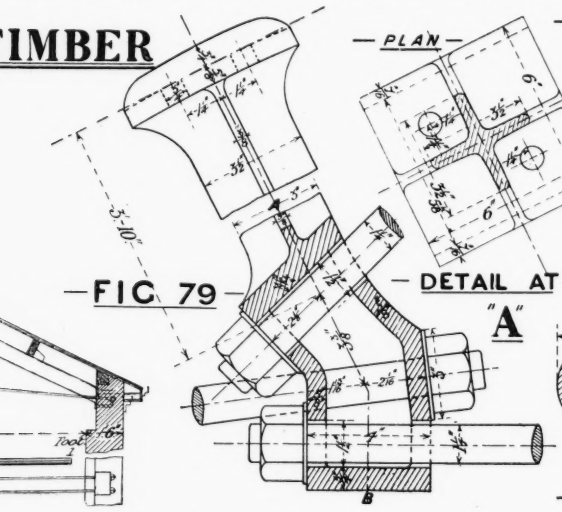
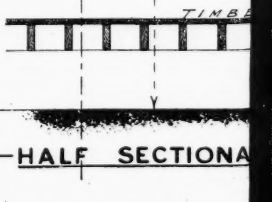
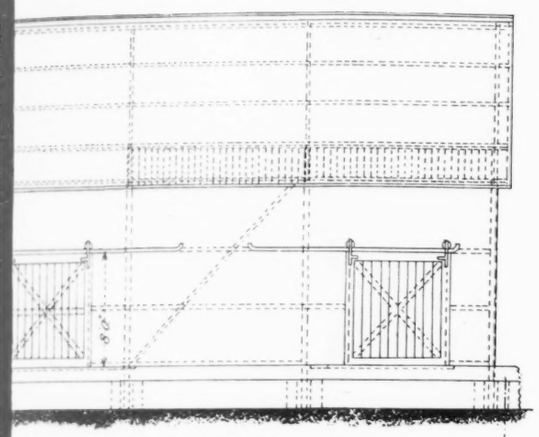


FIG 79



HALF SECTIONAL

OVER STORES. 94'-6" × 30'-0"



Scale for Figs. 74 & 75

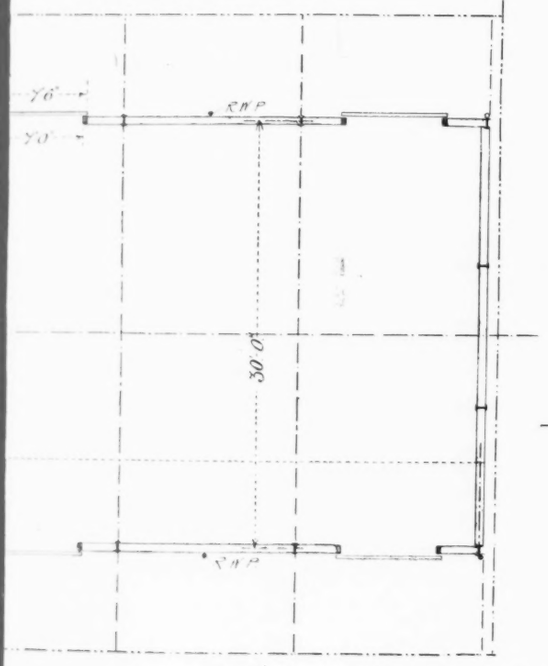


FIG 76

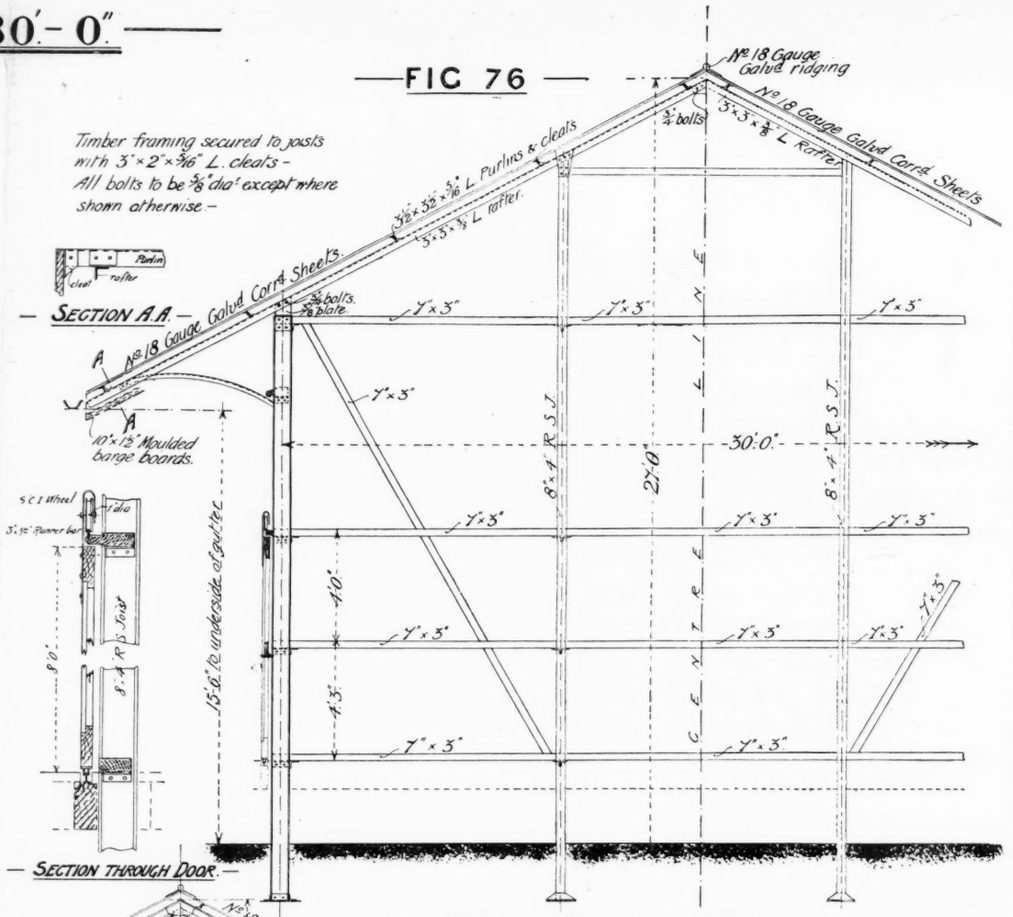
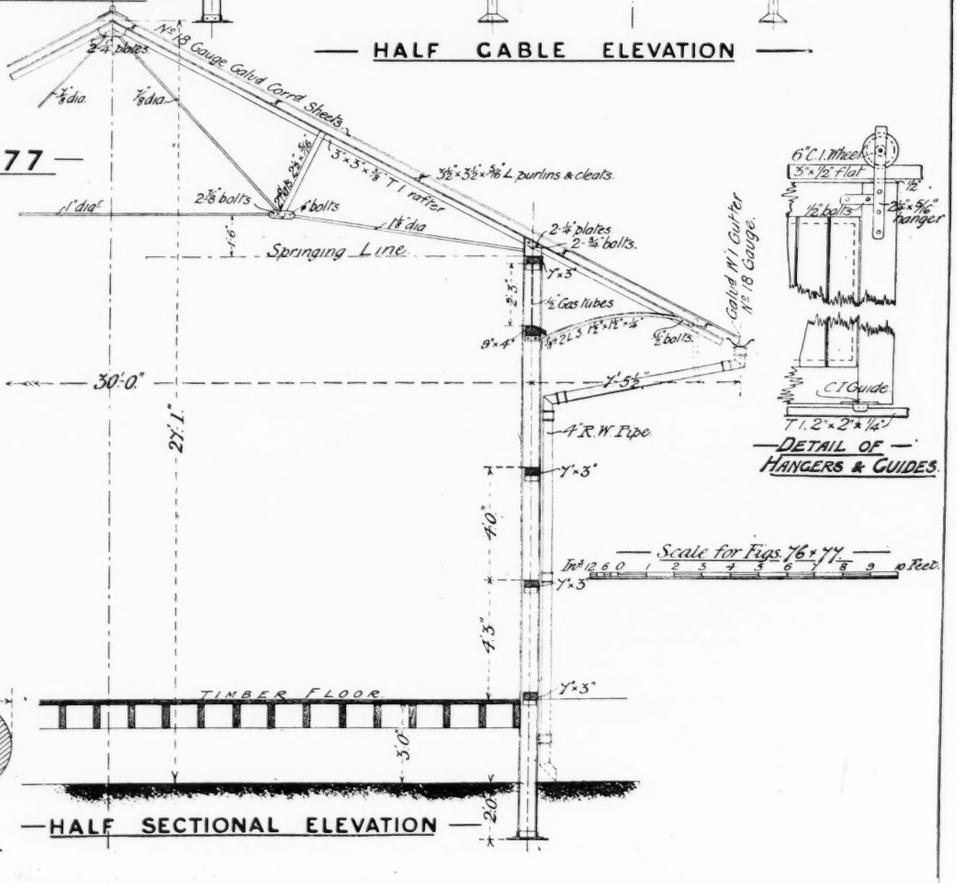


FIG 77



TIMBER

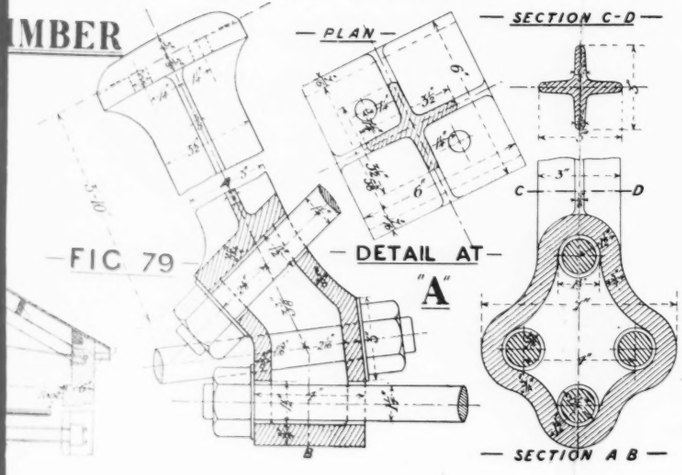
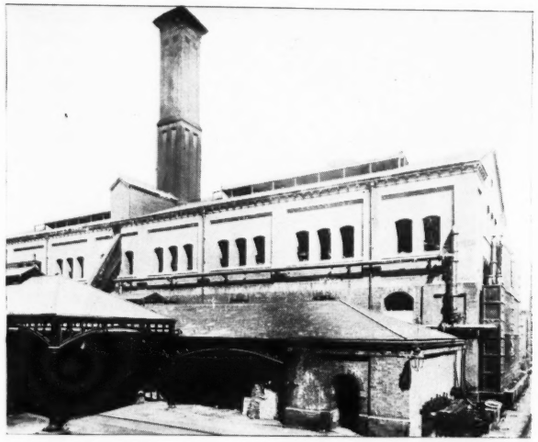
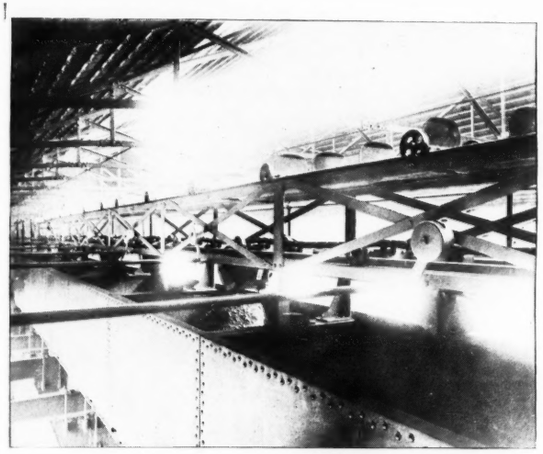


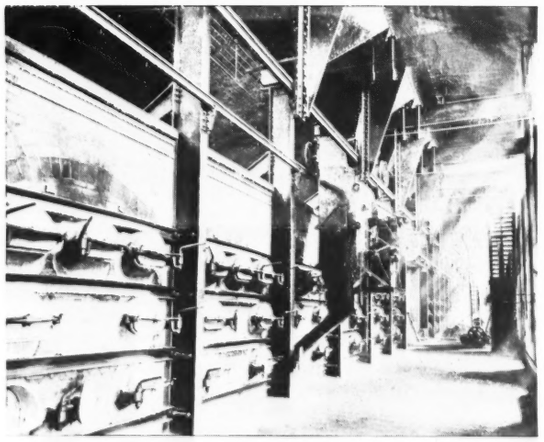
FIG 79



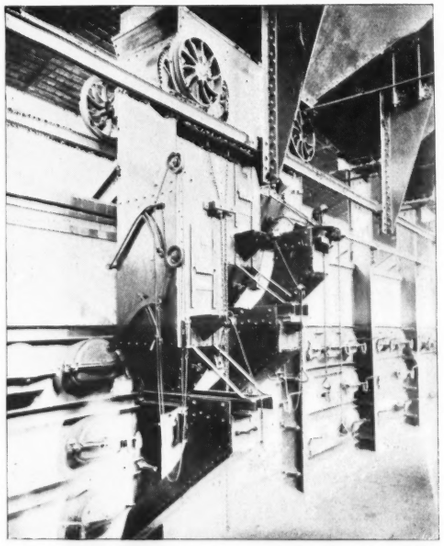
RETORT-HOUSE RAISED FOR RECEPTION OF INCLINED RETORTS.



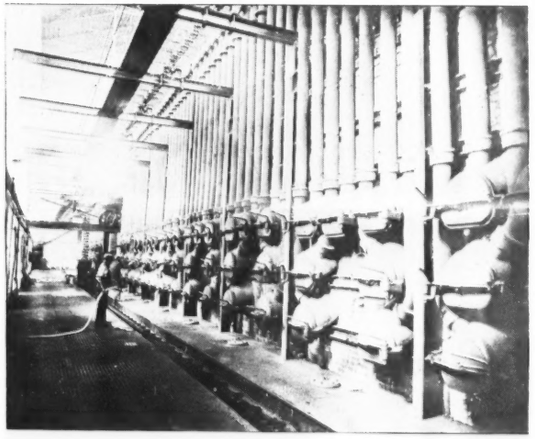
COAL CONVEYOR AND COAL HOPPERS.



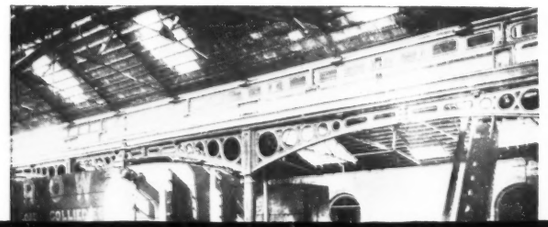
CHARGING FLOOR OF RETORT-HOUSE.

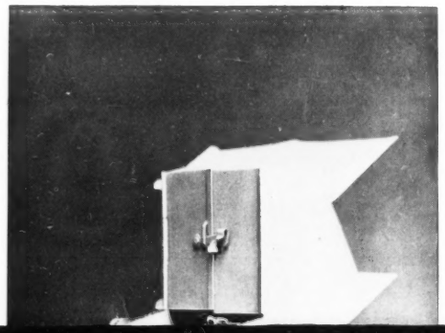


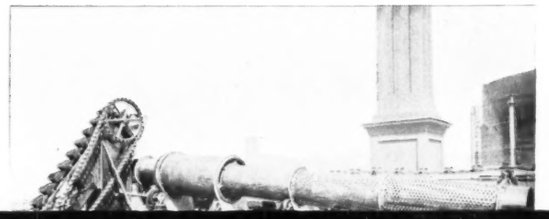
COAL CHARGING MACHINE.



DISCHARGING END OF RETORTS AND COKE CONVEYOR.

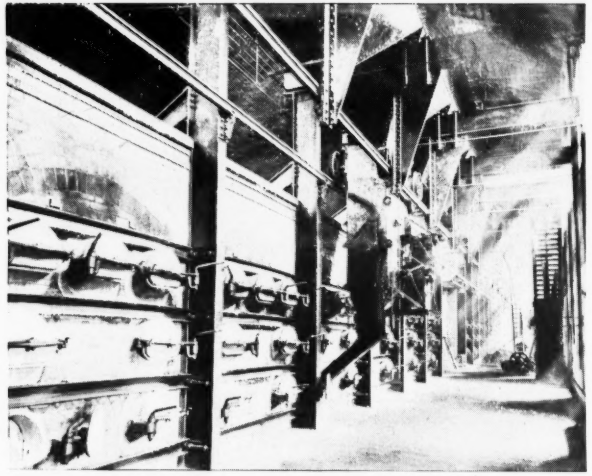




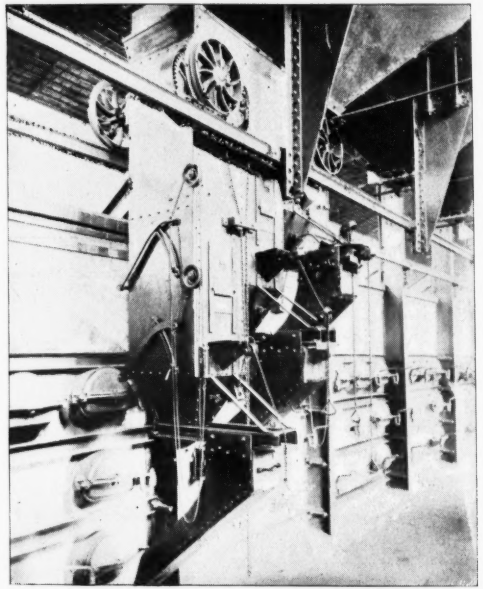


RETORT-HOUSE RAISED FOR RECEPTION OF INCLINED RETORTS.

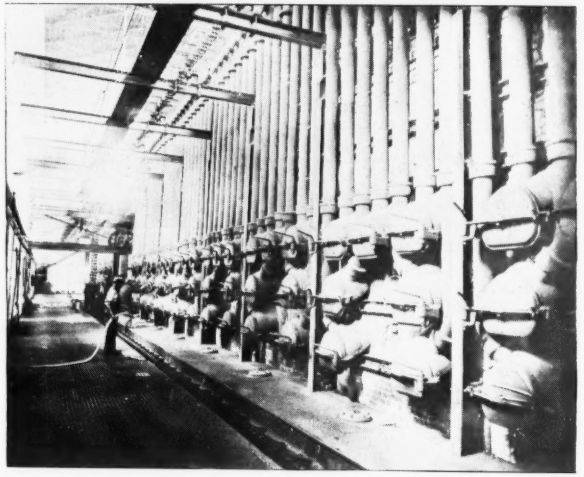
COAL CONVEYOR AND COAL HOPPERS.



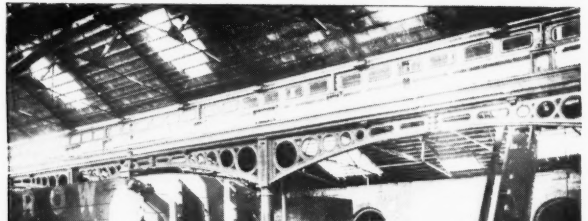
CHARGING FLOOR OF RETORT-HOUSE.

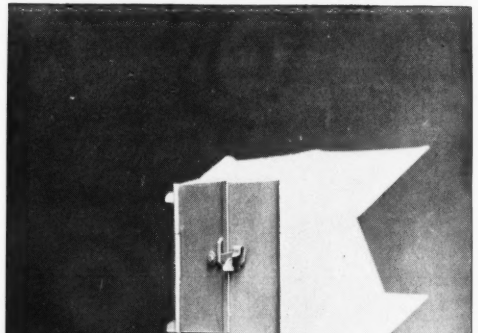


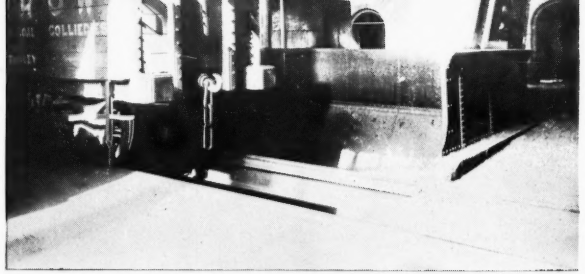
COAL CHARGING MACHINE.



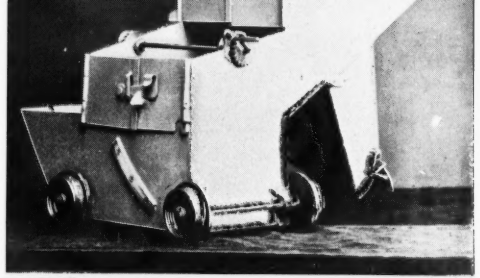
DISCHARGING END OF RETORTS AND COKE CONVEYOR.



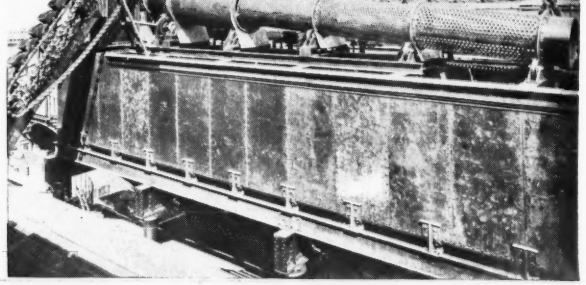




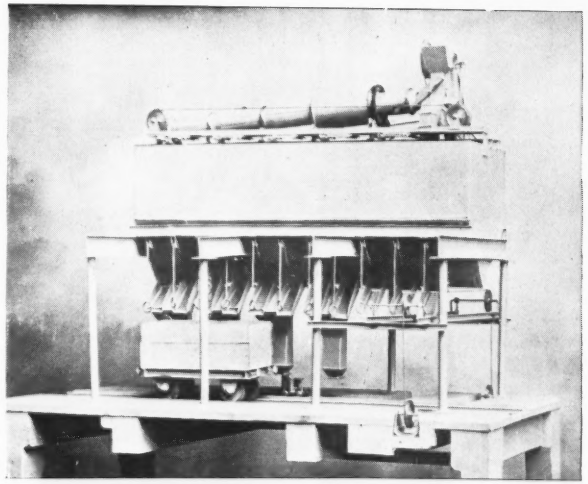
Coal Hopper and Breaker Below.



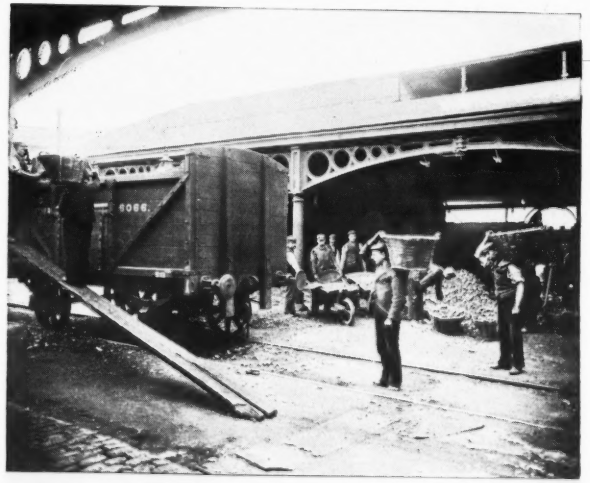
Portable Coke Discharging Shoot and Hopper.



Coke Hopper, showing Revolving Screen and Elevator Head.



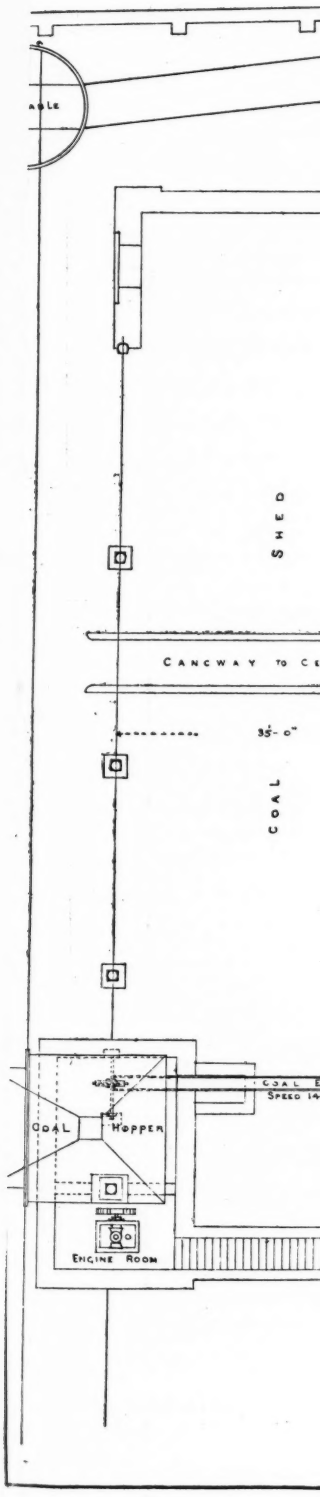
Overhead Coke Loading and Storage Hoppers.



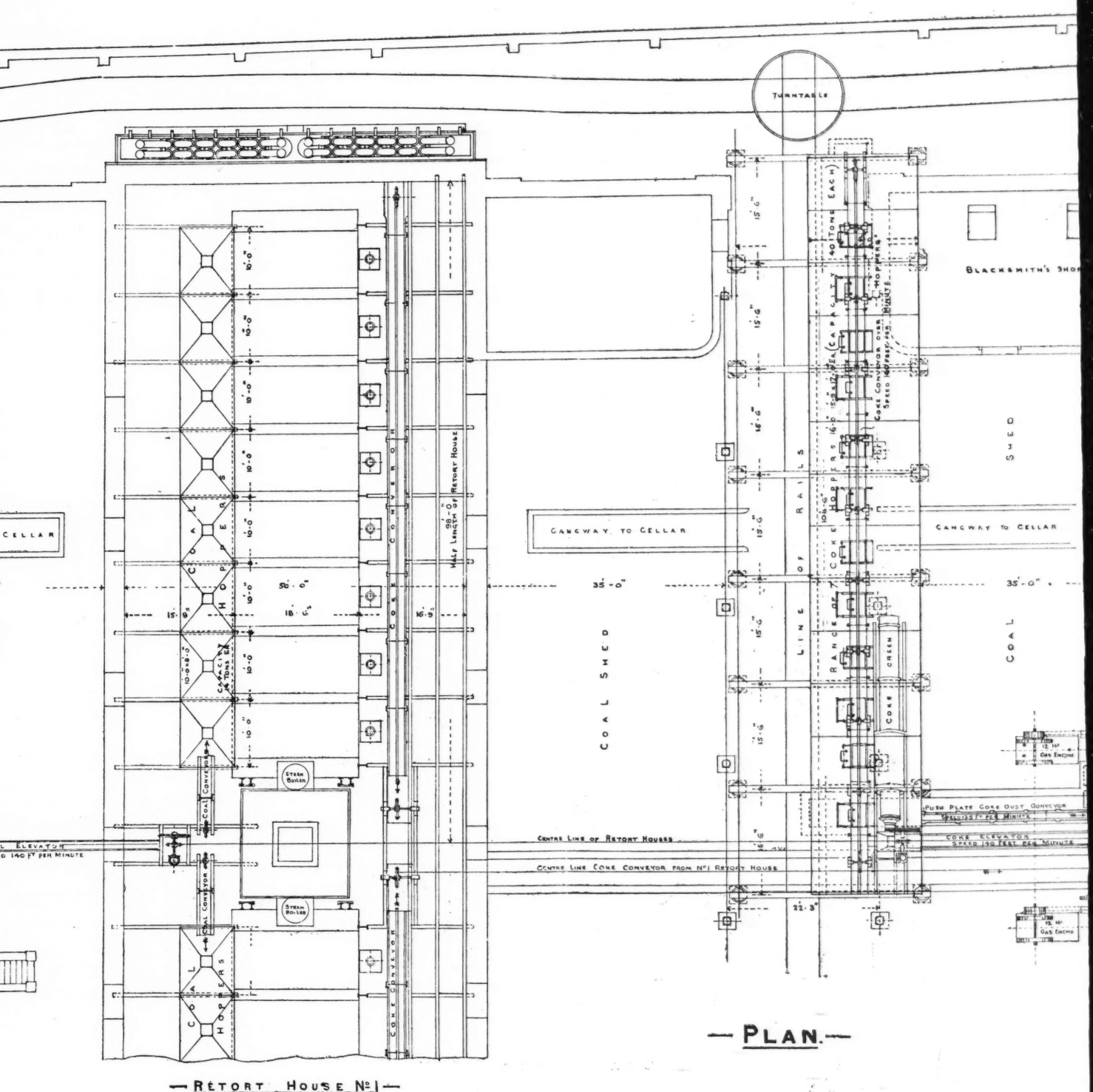
Old Method of Loading Coke into Waggons.

INCLINED RETORT HOUSE AT THE EASTCROFT GAS-WORKS, NOTTINGHAM—W. R. Chester, M.Inst.C.E., Engineer.

AUTO



MATIC STOKING W. R. CHESTER'S. INSTALLATION O COAL AND C

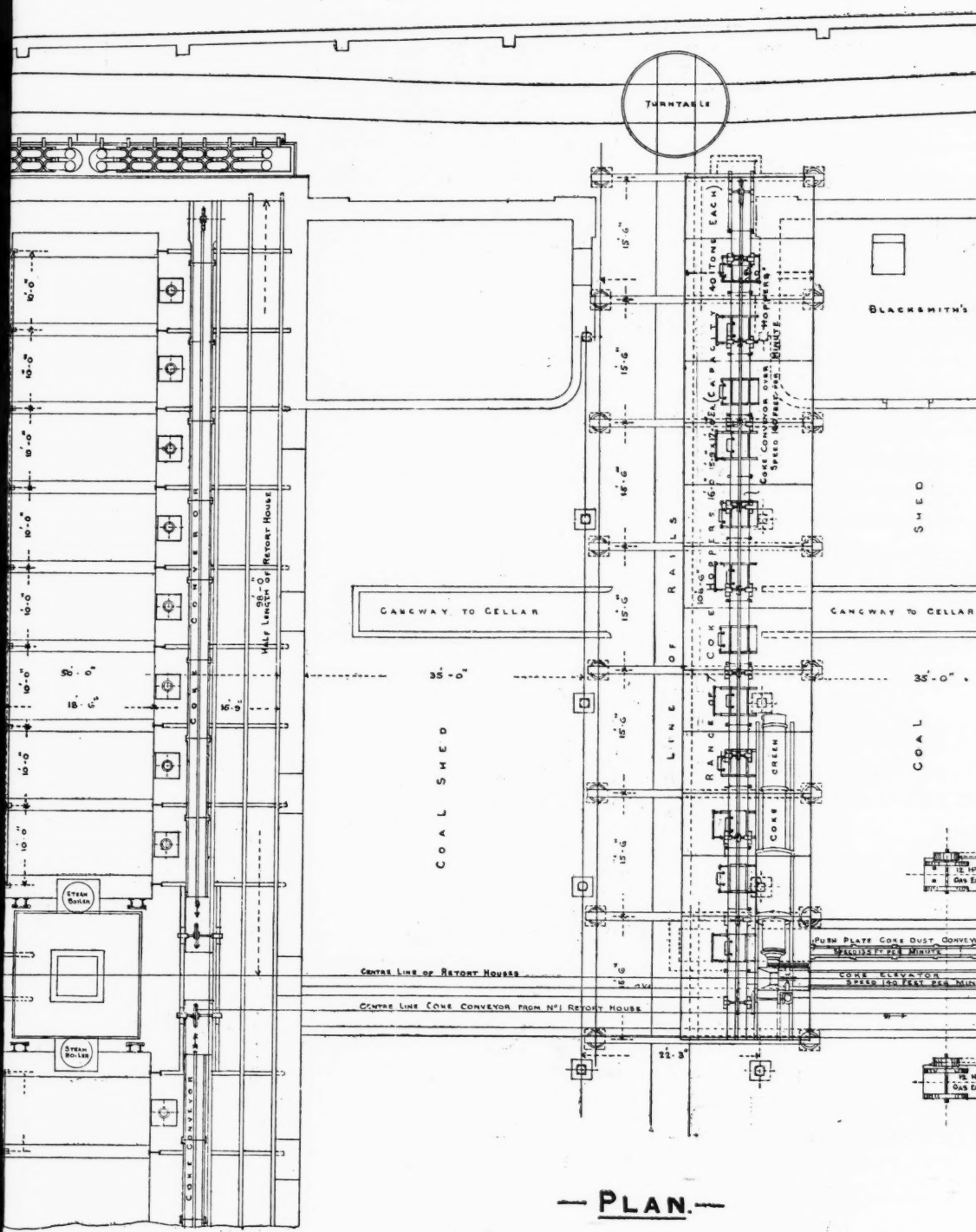


— RETORT HOUSE No 1 —

— PLAN. —

SCALE 8 FEET TO AN INCH

...OKING W. R. CHESTER'S. INSTALLATION ... COAL AND ...

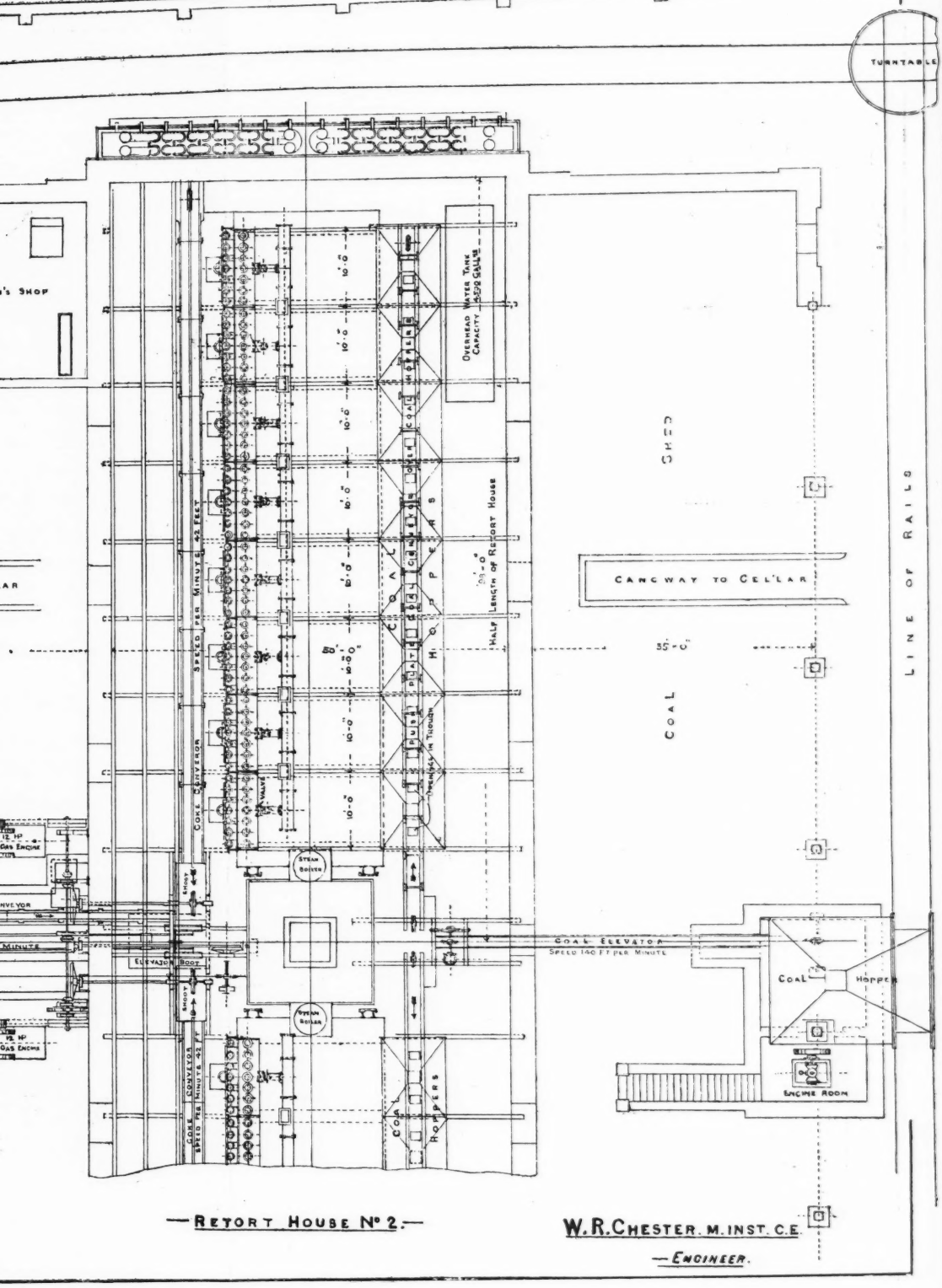


— PLAN. —

...ORT HOUSE No 1 —

SCALE 8 FEET TO AN INCH

N OF INCLINED RETORTS WITH COKE HANDLING PLANT

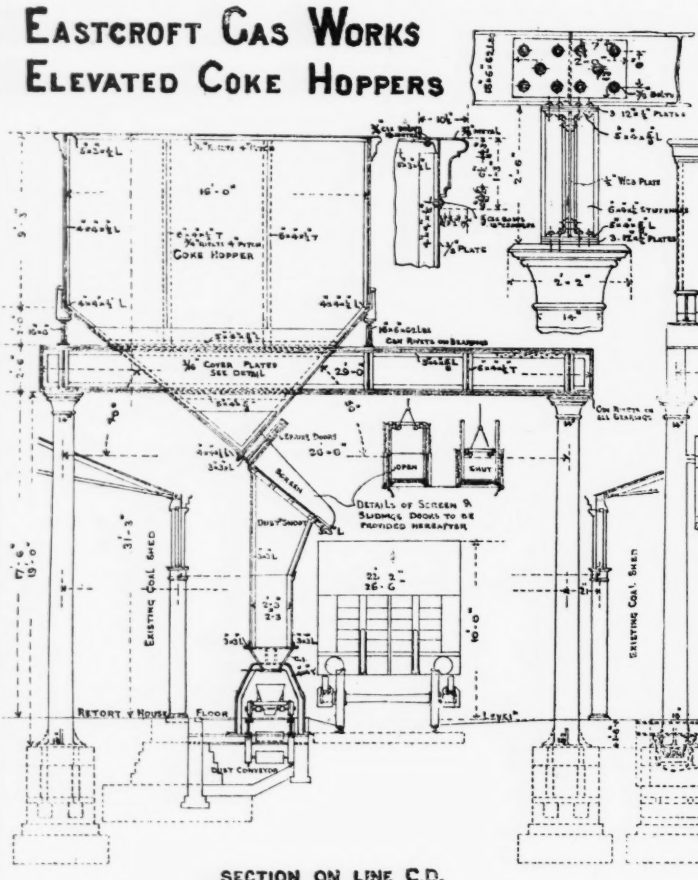


—RETORT HOUSE Nº 2.—

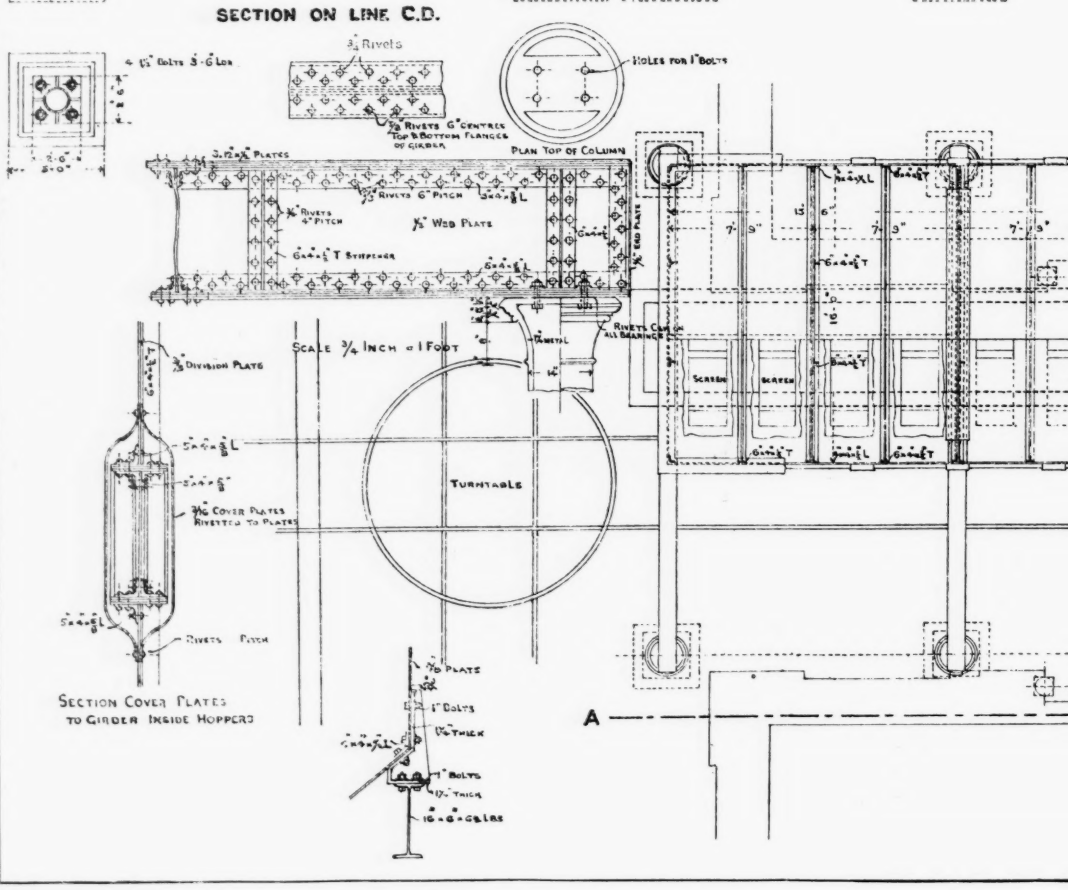
W. R. CHESTER. M. INST. C.E.
—ENGINEER.

EASTCROFT GAS WORKS
ELEVATED COKE HOPPERS

CO



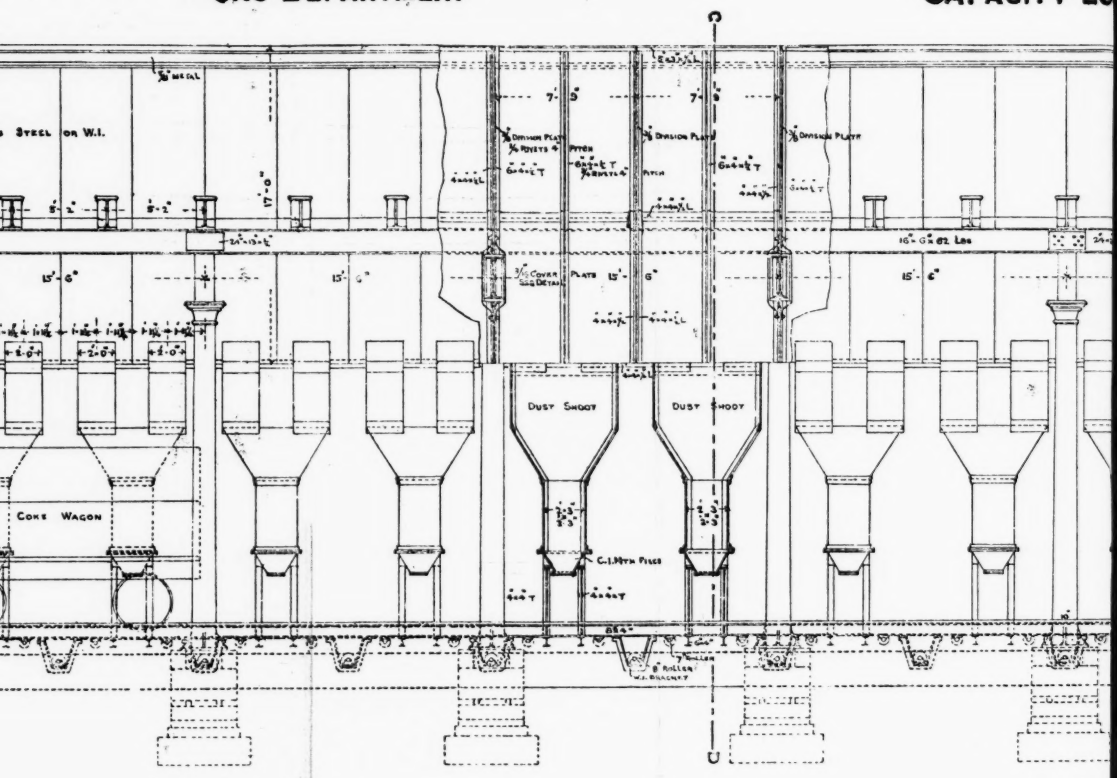
SECTION ON LINE C.D.



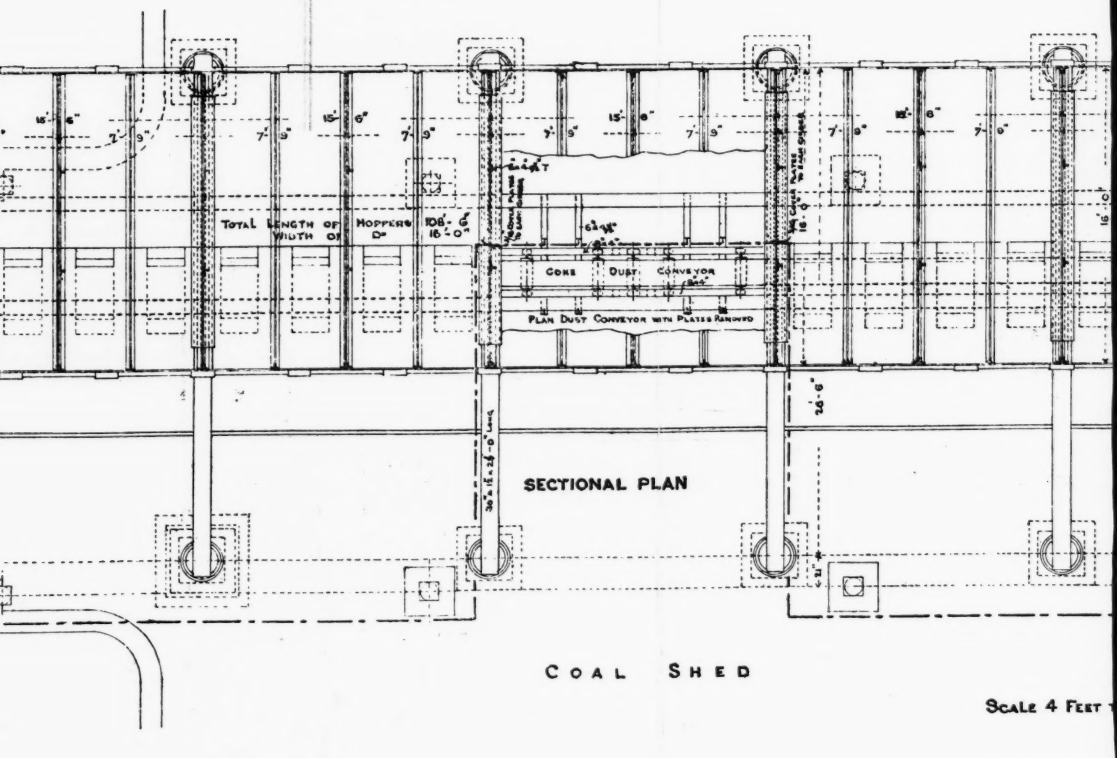
ORPORATION OF NOTTINGHAM

GAS DEPARTMENT

CAPACITY 28



ELEVATION & SECTION ON LINE A.B.



SECTIONAL PLAN

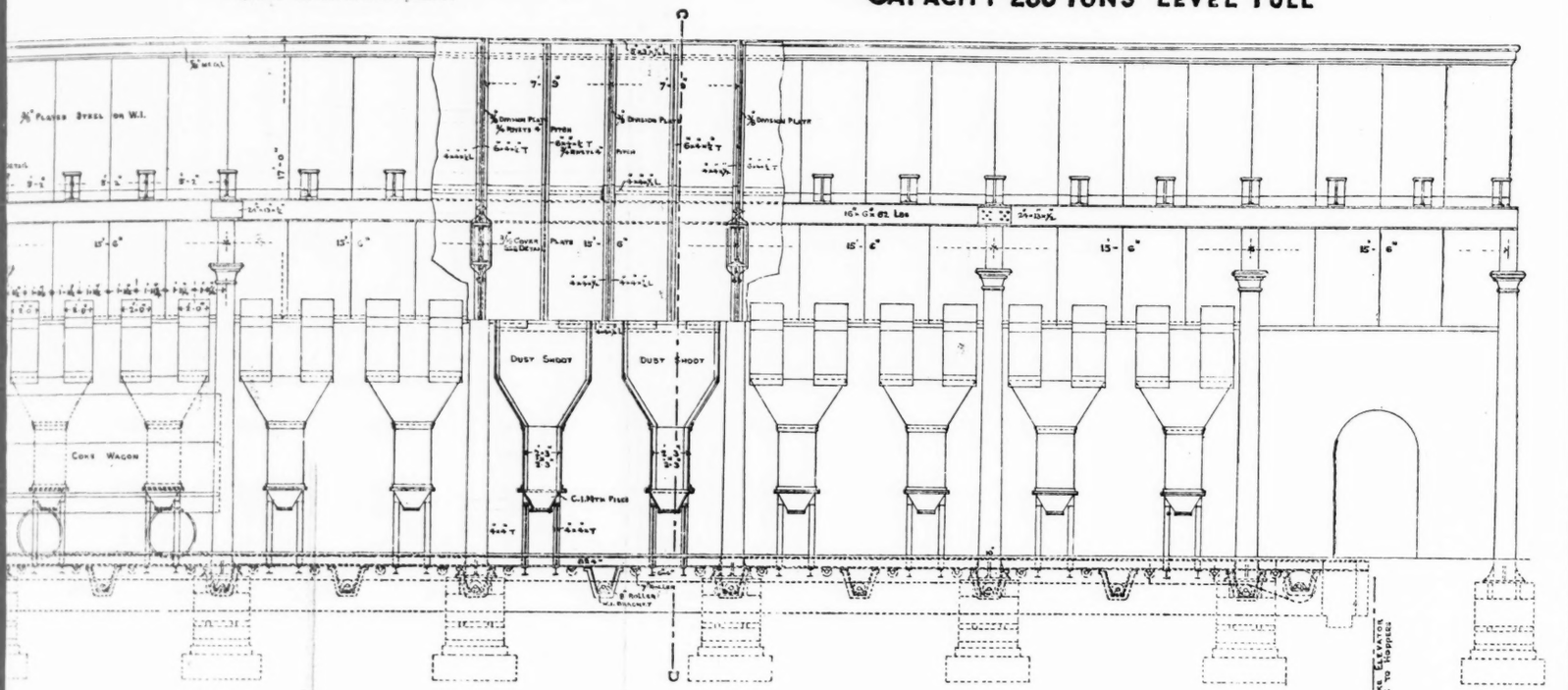
COAL SHED

SCALE 4 FEET

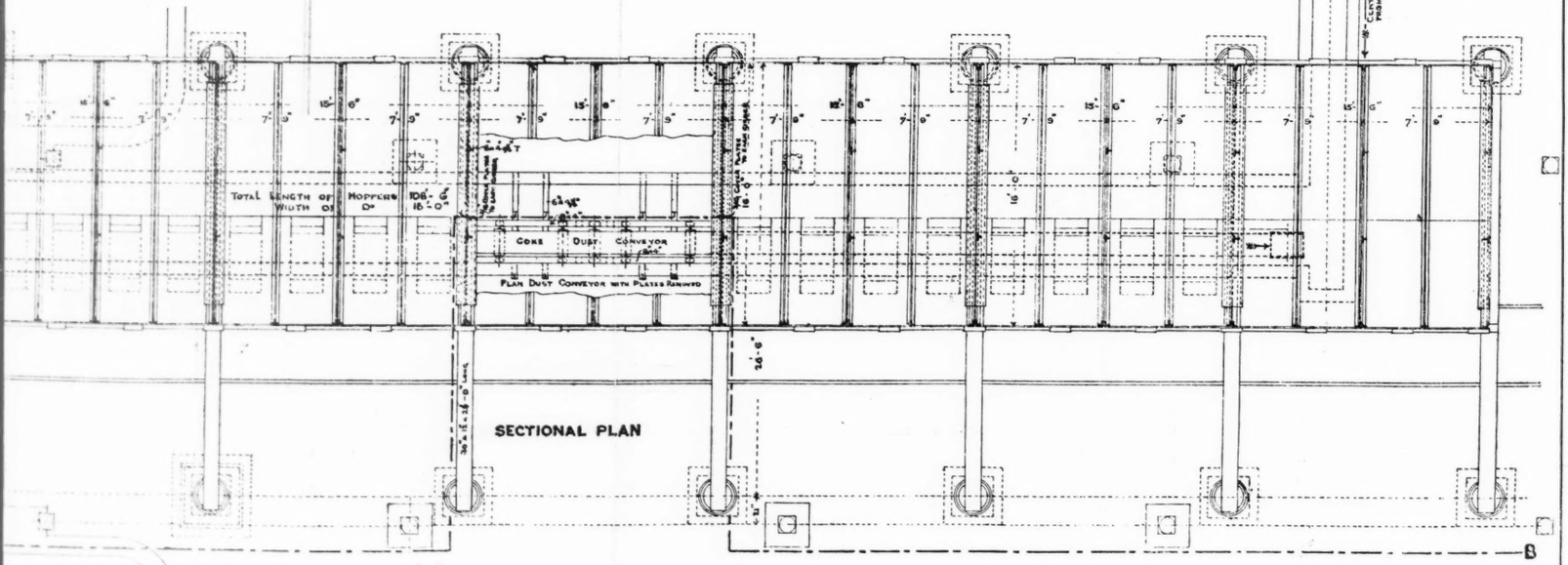
CORPORATION OF NOTTINGHAM

GAS DEPARTMENT

CAPACITY 280 TONS LEVEL FULL



ELEVATION & SECTION ON LINE A.B.



SECTIONAL PLAN

COAL SHED

SCALE 4 FEET TO AN INCH

W. R. CHESTER. M. INST. C.E.
ENGINEER.

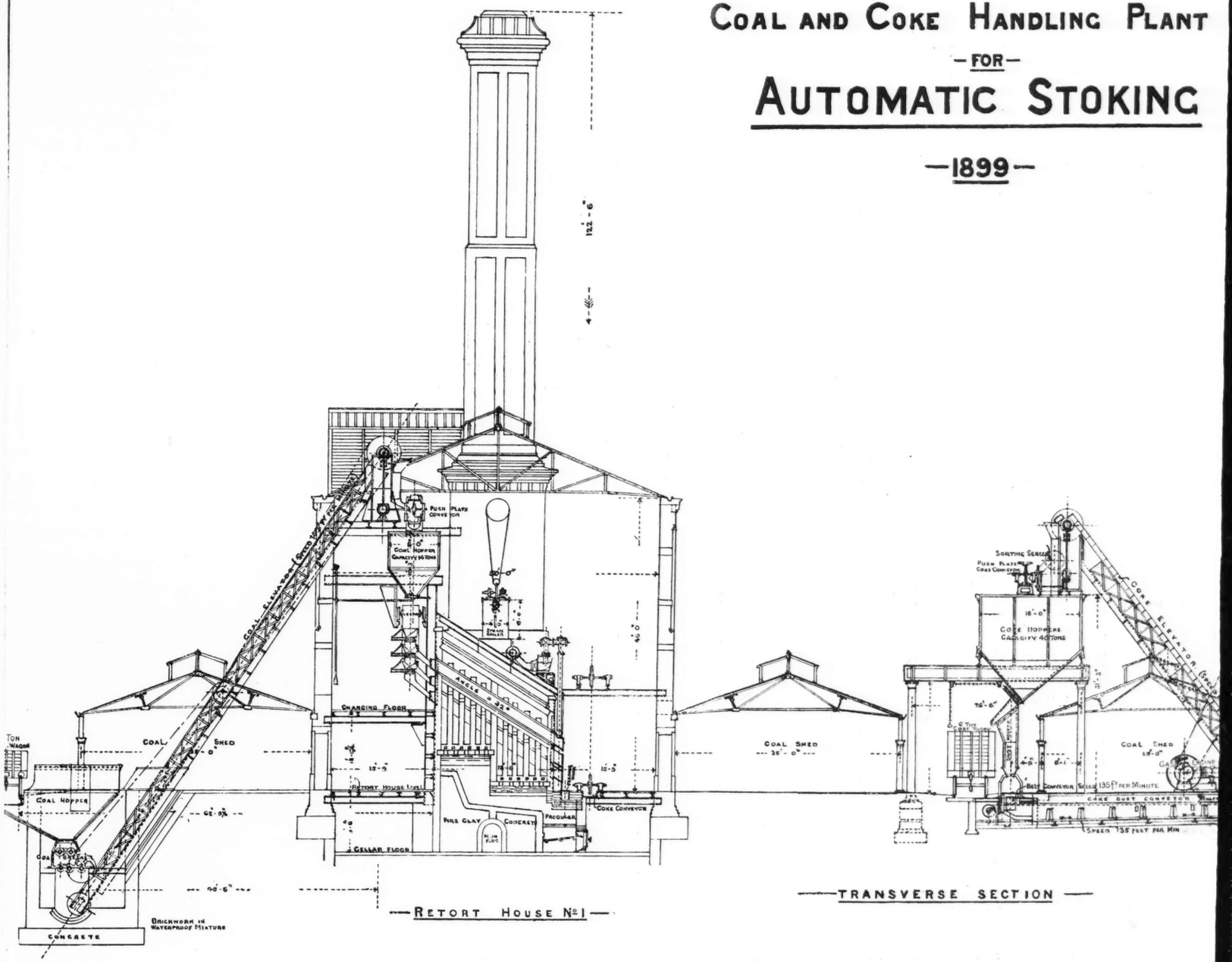
— W. R. CHESTER'S —

INSTALLATION OF INCLINED RETORTS WI
COAL AND COKE HANDLING PLANT

— FOR —

AUTOMATIC STOKING

— 1899 —



— RETORT HOUSE No 1 —

— TRANSVERSE SECTION —

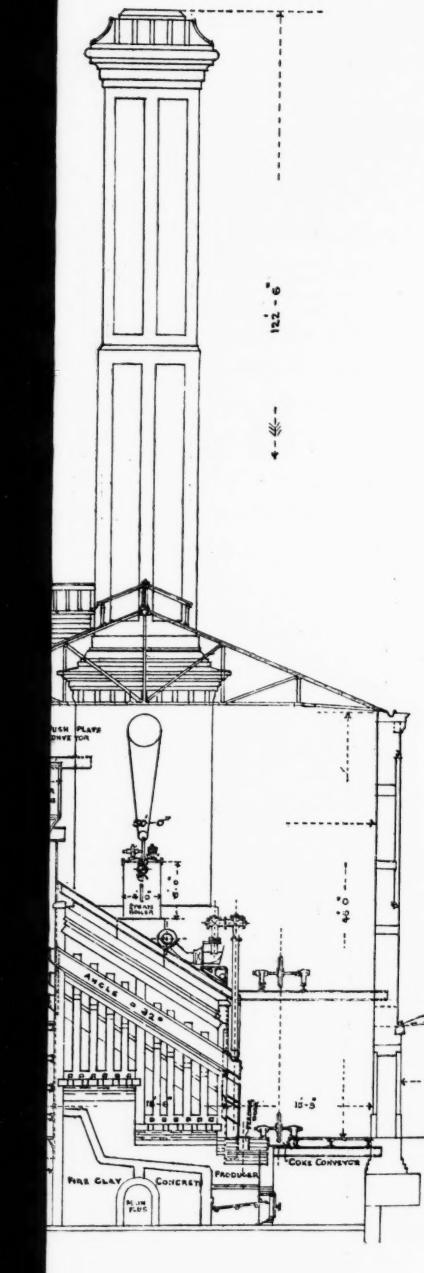
—W. R. CHESTER'S —

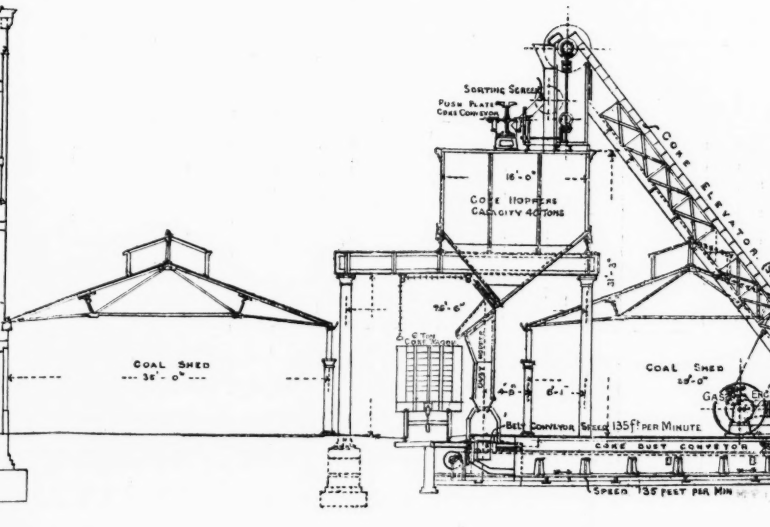
INSTALLATION OF INCLINED RETORTS W
COAL AND COKE HANDLING PLANT

—FOR—

AUTOMATIC STOKING

—1899—



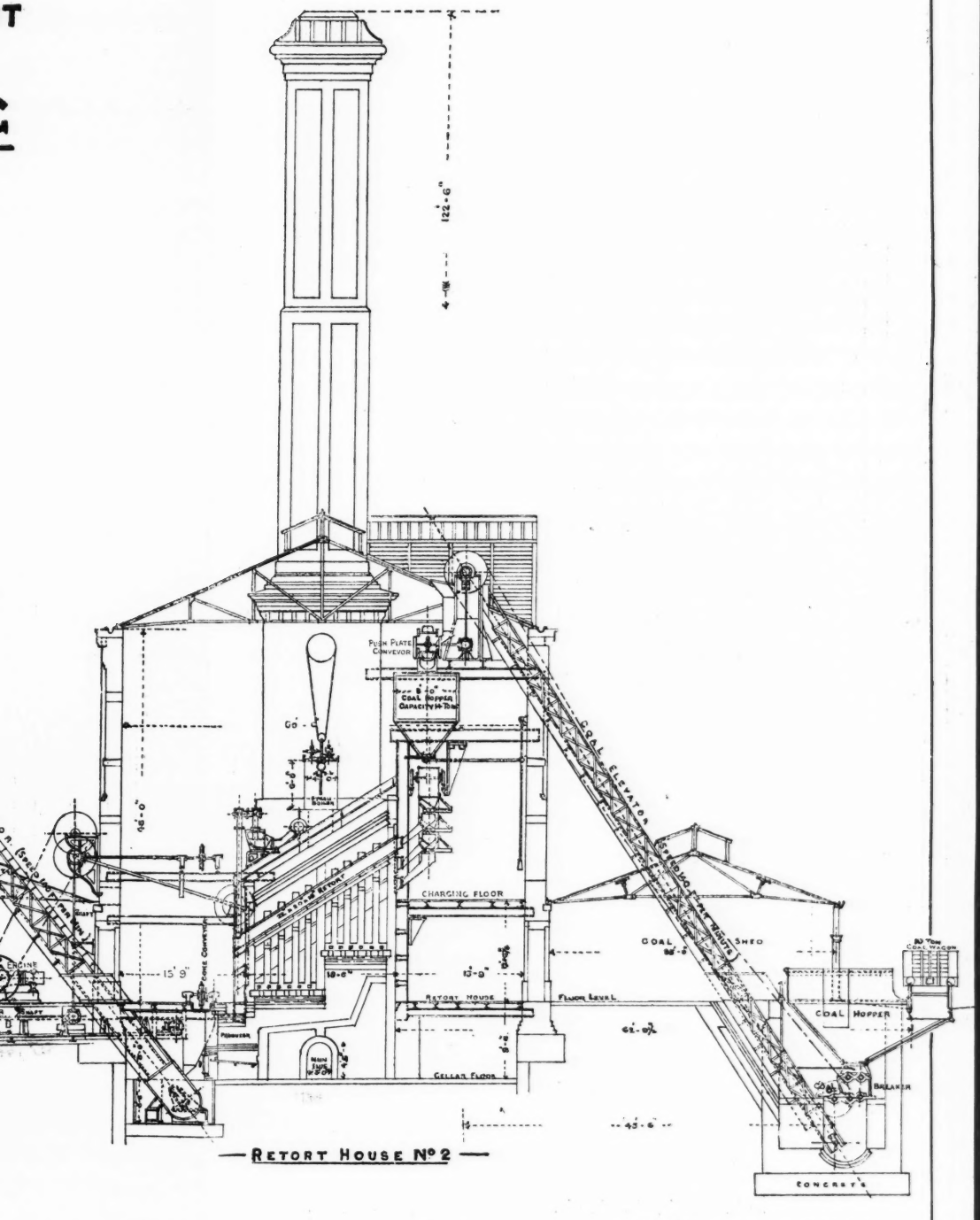


—TRANSVERSE SECTION —

ETORT HOUSE No 1 —

WITH

T

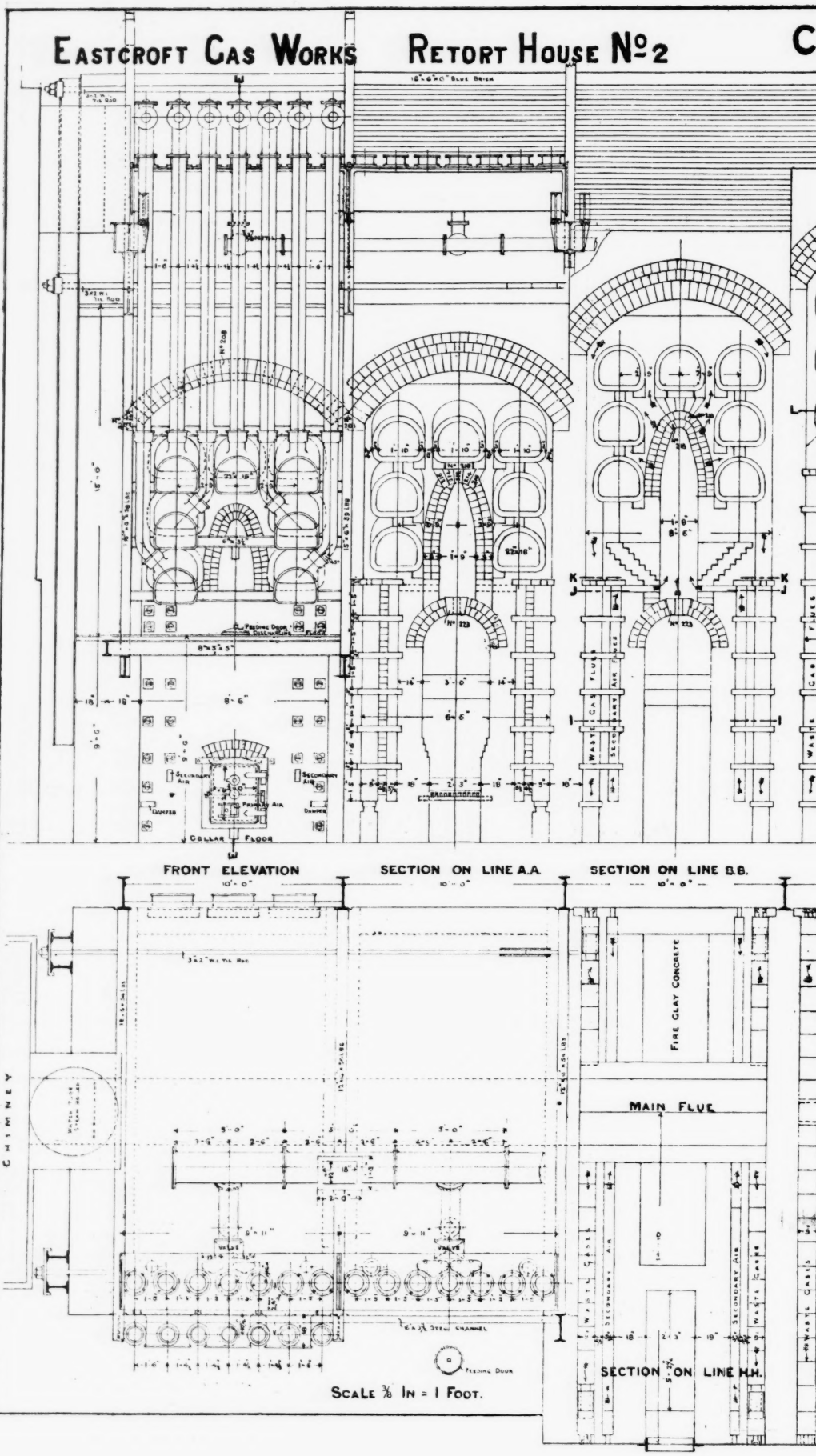


RETORT HOUSE Nº 2

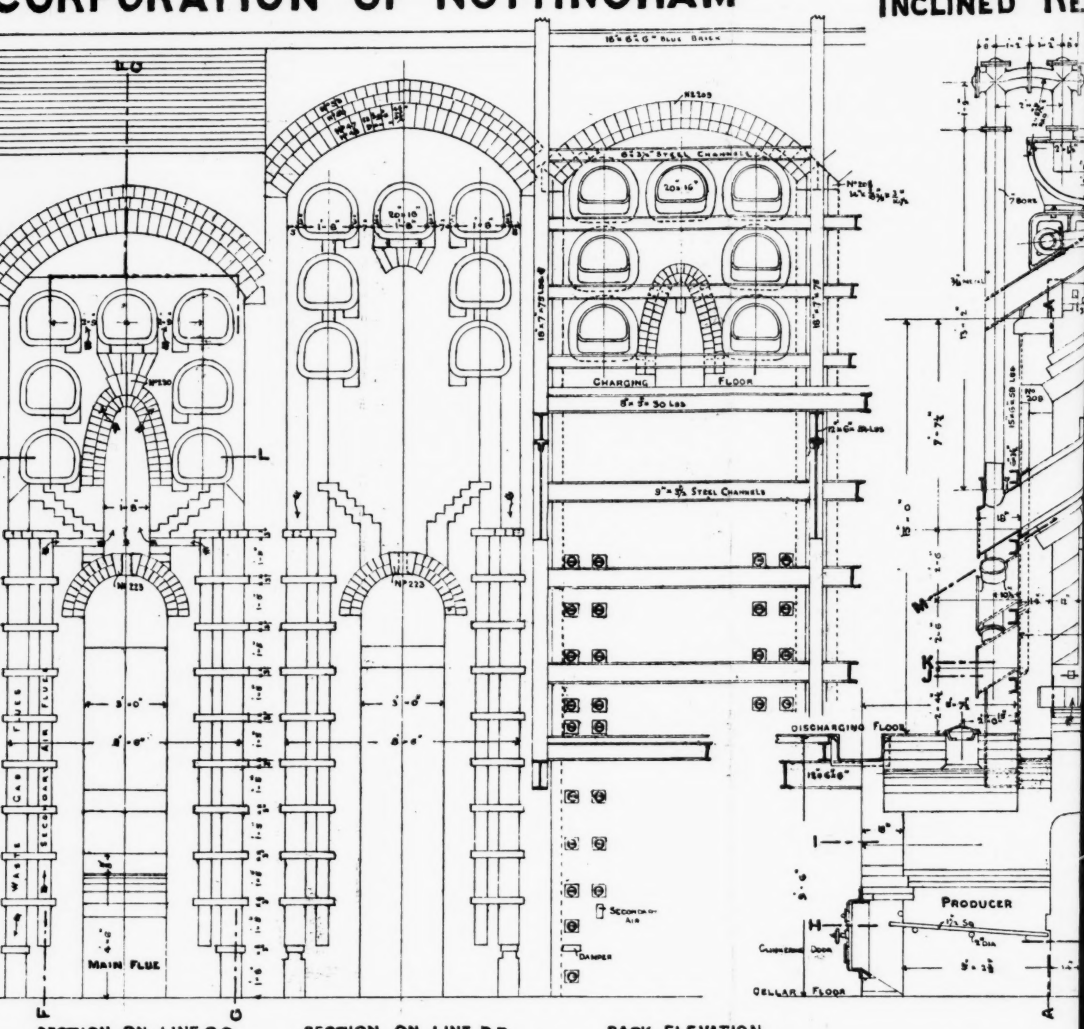
SCALE 8 FEET TO AN INCH.

W. R. CHESTER, M. INST. C.E.

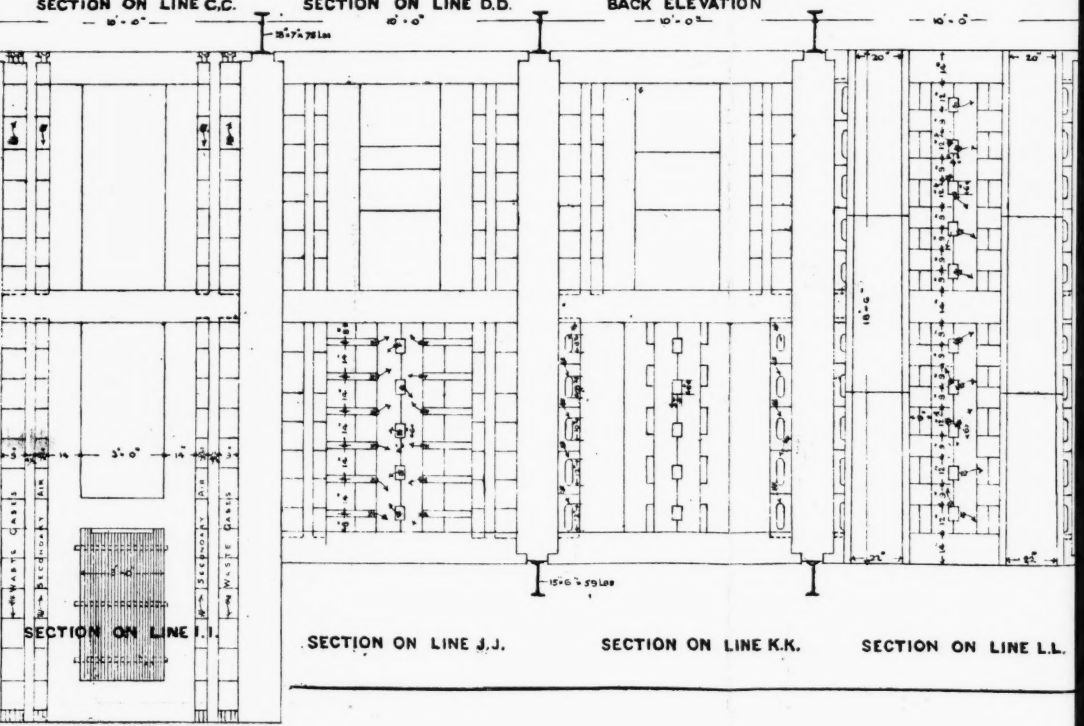
ENGINEER


EASTCROFT GAS WORKS
RETORT HOUSE Nº2
FRONT ELEVATION
SECTION ON LINE A.A.
SECTION ON LINE B.B.
SECTION ON LINE H.H.
CHIMNEY
MAIN FLUE
FIRE CLAY CONCRETE
SCALE ⅜ IN = 1 FOOT.

CORPORATION OF NOTTINGHAM INCLINED RE



SECTION ON LINE C.C. SECTION ON LINE D.D. BACK ELEVATION



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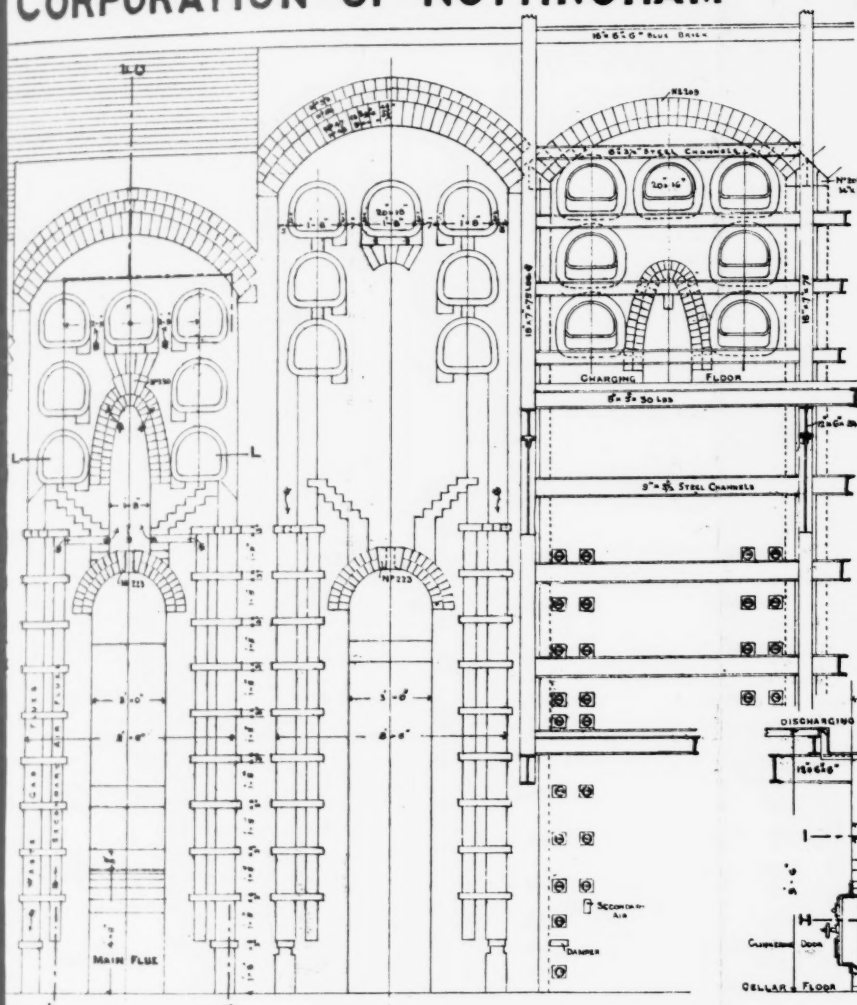
CORPORATION OF NOTTINGHAM



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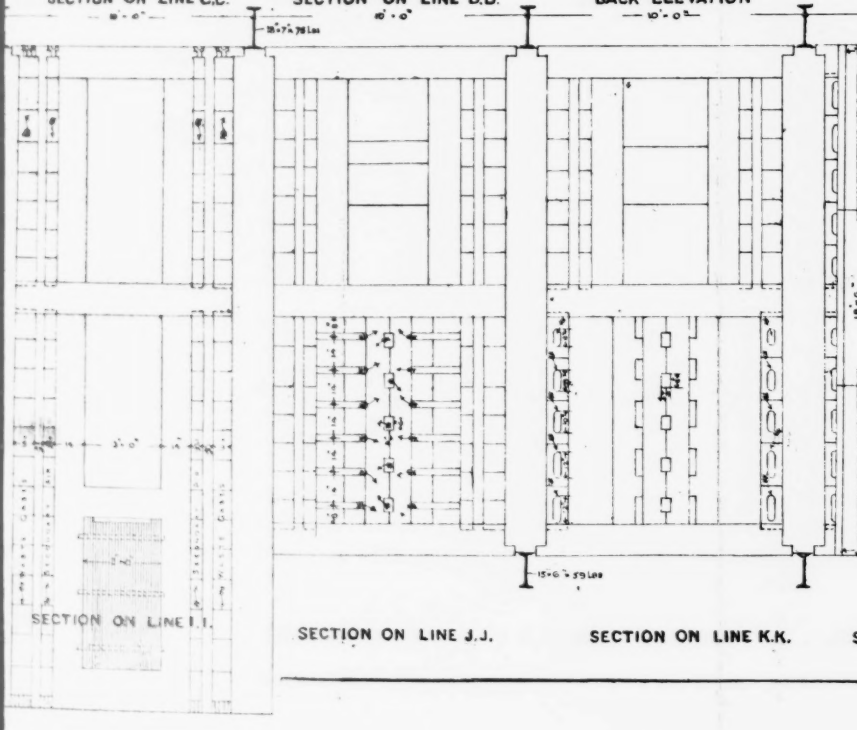

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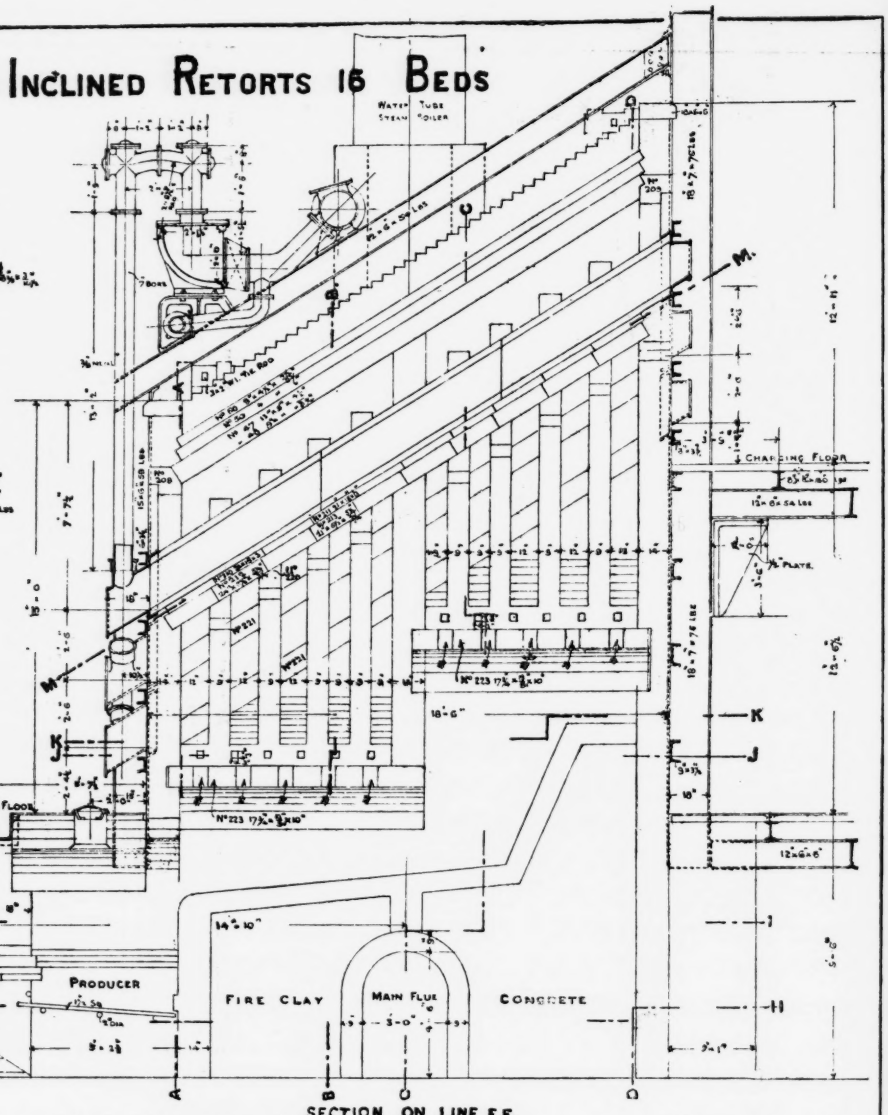

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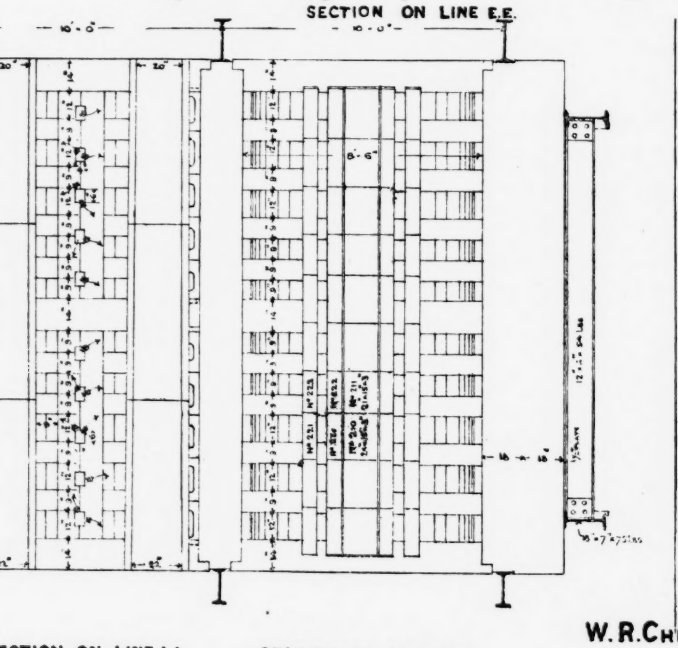


SECTION ON LINE L.L. SECTION ON LINE M.M.

W. R. CHESTER, M. INST. C.E.
ENGINEER.

complete plant, however large, from the generators to the burners, and guaranteeing the apparatus to fulfil all the conditions of perfect illumination.

It will be remembered that when Professor Lewes in January, 1895, first introduced the commercial possibilities of acetylene to a Society of Arts audience, much surprise was expressed by the scientific and industrial world, as at the time it was thought that the manufacture of carbide would be a simple and cheap process, and that it would be advantageous to use acetylene for enriching coal gas. But when it came to actual working on a large scale, it was found that this was far from being the case. From that moment, the Acetylene Illuminating Company recognized that, while acetylene had a place—and a large place—by itself as an illuminant, it could not be claimed for it that it might be used for enriching, or that it would supersede, or even compete as regards cost with, coal gas, because wherever coal-gas works exist incandescent mantles could be used with greater economical advantages. In all their pamphlets and published statements, therefore, the Company have studiously avoided any exaggerated claims as to what their future might be; and their recent action has, we believe, been the first step they have taken to prove that they are now in a position to work in conjunction with gas companies in the actual supply of a portion of their districts. We understand that Professor Lewes, who has been Scientific Adviser to the Company from the outset, is still being retained in that position.

The main question, of course, for gas directors and gas committees to decide is what advantage will accrue to their undertakings from the proposed departure; and time alone can answer this. As already mentioned, however, the Acetylene Illuminating Company have, from the outset of their existence, carefully avoided all exaggerated claims; and consequently any suggestion coming from them is worthy of serious consideration.

PERSONAL.

Mr. H. Hanan has resigned the position of Gas Manager to the Youghal District Council.

Mr. E. Mason has obtained the appointment of Manager of the Walton-on-the-Naze Gas-Works.

Mr. M'Farlane, of Kilmarnock, will succeed Mr. Easson as Manager of the Maybole Gas-Works.

The successor to Mr. H. Fowler as Gas Engineer to the Lancashire and Yorkshire Railway is Mr. G. H. Roberts.

Mr. Thomas Smith, the Borough Surveyor and Gas and Water Works Engineer of Darlington, has resigned the second-named position; and Mr. E. P. Tarratt, the Works Manager, has been appointed by the Committee to full control.

Last Tuesday, the employees at the Perth Gas-Works gave expression to the good feeling which has existed between them and the retiring Gas Manager, Mr. Andrew Wilson, by presenting him with a handsome bedroom clock, accompanied by two silver candlesticks for Mrs. Wilson. The presentation was made by ex-Bailie Wright; and the gifts were suitably acknowledged by Mr. Wilson.

Mr. P. C. Holmes Hunt has been appointed by the Gas Committee of the Birmingham Corporation to the charge of their Adderley Street works, recently vacated (through ill-health) by Mr. E. L. Pryce. The eldest son of Mr. Charles Hunt, Mr. Percy Hunt was educated at Malvern College and Mason University College, Birmingham, and is a Fellow of the Institute of Chemistry. For nearly four years he was assisting his father at the Windsor Street works, and has been in actual charge of the Adderley Street works since October last.

Mr. Frank Howarth, M.Inst.C.E., has been selected by the Plymouth Water Committee for the position of Water-Works Engineer to the Corporation. Mr. Howarth, whose early training was obtained in the service of the Water-Works Engineers to the Bradford Corporation, has been since 1883 assistant to Sir Alexander Binnie, the Chief Engineer to the London County Council. In this position, he has been associated with the various investigations which have been carried on with reference to the water supply of London, including the scheme to obtain a supply from Wales. He has also been engaged in marine surveying and tidal observations in the estuary of the Thames; and altogether he has had a very extensive experience. There were 34 applicants for the post; and the selection of Mr. Howarth was unanimous. The salary is £300 per annum, rising by annual increments of £25 to £500.

Mr. E. Sandeman, who is leaving the service of the Plymouth Corporation to take up the position of Engineer to the Derwent Valley Water Board, was on Friday presented with various tokens of the esteem in which he is held at Plymouth. The presentations, which were made publicly, consisted of a silver tray and candelabra with a gold watch and bracelet for Mrs. Sandeman, subscribed for by members of the Corporation and other residents in the town; and a silver tea and coffee service the gift of the municipal officials. Several members of the Corporation spoke in eulogistic terms of Mr. Sandeman's work, and congratulated him upon his appointment. The Town Clerk, in referring to the progress of the water undertaking, said that when Mr. Sandeman came to Plymouth, ten years ago, the revenue was £13,600, whereas it was now £22,000; while the expense of the department had increased only from £4000 to £4400. Ten years ago the supply was affected by drought and frost, and in dry summers fell to as low as two or three hours a day. It was now constant and abundant even in so dry a summer as that of last year. Mr. Sandeman, in reply, said the work he had been engaged in at Plymouth was a monument of what could be done by municipalities in the direction of carrying out work under their own administration.

OBITUARY.

James Robb.

The death occurred, on the morning of Sunday, the 17th inst., at the house of his daughter (Mrs. Shaw), in Market Street, Haddington, of Mr. James Robb, who was for many years Manager of the Haddington Gas Company. Mr. Robb was the doyen of Gas Managers. He was born at Kippielaw, about a mile from Dalkeith, on Sept. 14, 1808, and was thus 92 years of age. His father had a joiner's business; and some time after the birth of his son he removed to Whitehill, where he got a feu of land from the late Duke of Buccleuch, and built a house. James Robb was educated at the village school there, and afterwards served his apprenticeship with his father as a joiner. A few years later he went to London, where he remained for some years. On his return to Scotland, he was appointed foreman over the joiners and smiths connected with the Duke of Buccleuch's colliery at Thorniebank, and so gained an extensive knowledge of coal working, which served him in good stead when in 1847 he was appointed Manager of the Haddington Gas Company, a post which he held for 41 years, and then retired with a life pension. He took a great interest in geological and antiquarian research, and wrote a considerable number of articles on antiquarian matters for various periodicals. Mr. Robb was the first to discover that valuable ironworks might be developed at Garleton, on the estate of the late Sir Thomas Buchan-Hepburn, Bart. These were leased by the Summerlee Company, and a great deal of ore was extracted. Through some dispute, however, the works were stopped; but those who were interested presented Mr. Robb with a gold watch and a purse of sovereigns, for his services. Many of his inventions were sent to the Royal Scottish Society of Arts; and for one of these—a stop cock for corrosive fluids—he received a silver medal. The model was exhibited as far back as April 24, 1848. Mr. Robb was looked upon locally as the best authority on antiquarian matters relating to the burgh and neighbourhood of Haddington. The deceased was married to Miss Waldie, of Dalkeith, who predeceased him 36 years. He is survived by two sisters and a brother, one son and three daughters. Till about a month ago, Mr. Robb was constantly walking about the town and chatting to his friends. He had an attack of influenza, which was followed by congestion of the lungs, from which he died. There was a large turnout at his funeral on Tuesday to Haddington Churchyard. Mr. Robb was President of the North British Association of Gas Managers in 1880, when that body met in Perth. He had also held the office of President of the Waverley Association of Gas Managers. His reminiscences of the early days of the gas industry were many and were most entertaining.

The recent sudden death is announced of Mr. G. Sumner, formerly Manager, and since about a year Superintendent, of the Ilford Gas-Works. He was in his 61st year.

The many friends of Mr. George R. Hislop, of Paisley, will, we are sure, unite with us in offering our condolences with him on the severe bereavement he has sustained by the death of Mrs. Hislop, which occurred at their residence, Craigielea, Paisley, early last Tuesday morning, in her 59th year. The funeral took place at Biggar on Friday.

We regret to learn of the death, on the 8th inst., of Mr. J. Steel Johnson, Assistant-Manager of the Pará (New) Gas Company. Immediately prior to leaving England, about two years since, for South America, on a three years' engagement with the Company, Mr. Johnson was with Mr. W. J. Carpenter, at the Yarmouth Gas-Works; and he had previously been employed at Beckton and as Assistant at the Gorleston and Southtown Gas-Works. Deceased, who was a young man of considerable promise, succumbed to an attack of yellow fever, at the early age of 26.

One of the most beautiful of the exhibits at the Royal Society *soirée* last Wednesday—the "ladies' night"—consisted of a series of vacuum tubes charged respectively with samples of the various new gases which Professor W. Ramsay and Dr. Travers have succeeded in separating from the atmosphere. These gases are five in number—viz., helium, neon, argon, krypton, and xenon. The apparatus employed in separating the gases from each other and from the air was also on view. The process is one of fractional distillation. A comparatively large vacuum vessel is filled with liquid air. Into this liquid dips a narrower tube sealed at the bottom, and connected at its upper end with a mercury aspirator. In this narrow tube impure argon is liquefied; and on the aspirator being operated, the more volatile impurities distil over first, and can be collected for further examination or purification.

NOTES.

Tests of the Pohle Water Raiser.

At the engineering laboratory of the Berlin Technical High School, some interesting experiments have been carried on with the object of determining the efficiency of what is now called the Pohlé system of raising liquids by air. These appliances are well styled in French *émulseurs*, because they work on the principle of creating within the well pipe a temporary emulsion of water and compressed air, which is forced up by the greater weight of the unaërated fluid outside the pipe. The discovery of this means of lifting fluids appears to date from 1797; but it has recently been perfected as a speciality by several firms, among others that of A. Borsig, of Berlin and Tegel. The pump requires a comparatively deep well; and alongside the rising pipe is fixed the air pipe, which in the Borsig pump ends at the bottom of the former in a ring, so that the air enters radially from all sides. The advantages of the system are that the so-called pump has no valves, and that it will raise sandy or muddy water, hot water, and acids. The immersion depth of the well-pipe should be about equal to the height to which the fluid is to be raised; and the ratio should not exceed 3 to 2. The proportion of air used to water lifted ranges from 1·65 to 2·5, according to the height. The speed of the upward current should not go much beyond 6 feet per second. A rising pipe 70 millimetres diameter appears to be a good working size. The compressed air water lifter has about the same efficiency as the pneumatic motor, according to the determinations of Professor Josse, who, however, expects it to become increasingly popular owing to its cheapness and simplicity.

The Prospects of Cheap Coal from Alabama.

It is stated in "Engineering" that the centre of possible American exports of coal to Europe will be the State of Alabama, and the chief port Mobile. Hitherto, the great handicap which has prevented American coals from competing for the Atlantic trade is the long distance of the important coalfields from this coast. Baltimore, Newport News, and Norfolk are comparatively favourably situated as regards the coalfields of Virginia, West Virginia, and Kentucky; yet last year the price of coals at the pits was from 3s. to 3s. 9d. per ton, while the price f.o.b. at these ports of lading was about 7s. 3d., and is now close on 12s. per ton. Alabama coal is stated to be equal to any American coal for all purposes; and in the near future there is expected to be a heavy surplus production for export. The chief deposit is in what is called the Warrior field, which has from 30 to 35 seams of coal, half being over 2½ feet thick, and six of them 4 feet thick and over. Almost every variety of coal is found here. House and gas coals abound. The Assistant State Geologist, Mr. M'Calley, speaks in the highest terms of their quality. The coalfield is traversed by the Warrior River, from which it takes its name. The cost of extracting the coal throughout the field averaged last year under 2s. 6d. per ton, including interest on capital and placing on rail. No doubt it is higher now. Colliery owners are getting 5s. 10d. per ton at the pit. At present there is only land carriage for it, which keeps it local; but the Government are making progress with rendering the Warrior River navigable to tidewater at Mobile. When this work is done (about the end of next year), it is expected that Alabama coal will be put on board at Mobile at a total working cost of 4s. per ton. Value of the coal and freight added, the total charges will still be low enough to give this product the command of a wide market.

Recent Developments in the Acetylene Industry.

In a contribution to the "Chem-Gesell." of Stockholm, M. Lundstrœm gives, as the result of a large number of analyses, the following figures for the composition of acetylene now made from commercial carbide of calcium:—

	Min.		Max.
Sulphuretted hydrogen	—	..	1·340
Phosphoretted hydrogen	0·03	..	1·700
Siliciuretted hydrogen	—	..	0·800
Arseniuretted hydrogen	—	..	0·004
Ammonia	0·06	..	2·800
Carbonic oxide	—	..	1·480
Hydrogen	0·07	..	0·270
Nitrogen	0·20	..	2·910
Oxygen	0·55	..	1·180

In the event of insufficient cooling during the preparation, the acetylene may also contain benzene vapour. In a general way, commercial carbide of calcium gives a gas containing 99·5 per cent. of acetylene and 0·5 per cent. of other gases. The oxygen and the nitrogen come from the air enveloping the pieces of carbide. The presence of hydrogen is due to the metallic calcium formed by the dissociation of the carbide at a high temperature. The raw acetylene may even contain as much as 20 per cent. of this gas. The siliciuretted hydrogen probably comes from the silica which is always present in the lime used; as for the ammonia, it comes from the nitride of magnesium. Finally, the sulphuretted hydrogen is due to sulphide of alumina, and the phosphoretted hydrogen to phosphide of lime. A large number of methods have been proposed for the purification of acetylene. Lunge and Cedercreutz recommend chloride of lime; Frank proposes acid solutions of metallic salts (ferric chloride or cupric chloride in hydrochloric solution); Ullmann uses an acid chromic solution; and Stern passes the gas through petroleum, alcohol, or benzene. In actual practice, nearly all the impurities are absorbed by the lime water, and a simple washing with water will even suffice, unless the gas contains a large quantity of phosphoretted hydrogen, in which case a more complete purification will be necessary. According to the author, Frank's method should be preferable to any other. Finally, Bunsen burners have been made by means of which acetylene can be used for heating purposes.

A Combination Power Plant.

At the present time, when the distribution of energy in the form of electricity threatens to become a fashion in engineering, it is useful to learn that even in America electric power is not regarded as suitable for all purposes. An interesting account recently appeared in the "Engineering Record" of a combination power plant (the second of the kind) established for the public supply of light, traction, and power to the famous Cripple Creek gold mining district of Colorado. The novelty of the undertaking consists in its being one of the first ventures for providing power to small users at less cost than they could develop it individually, where there are no natural advantages or coal deposits to specially favour power generation in bulk. The power-house is accordingly situated conveniently for the customers, on the side of a mountain in the middle of the mining district, and away from water courses and coal mines. It is consequently the exact converse of the Niagara class of power-in-bulk schemes. The business of the Company is the supply of electric light and power, compressed air, and water. The electricity output is by alternating current, distributed over a radius of six miles, and used chiefly for hoisting, pumping, and ore crushing in the mines. The compressed air is distributed within a radius of two miles, by ten miles of pipes; and is used for air drills, blacksmiths' forges, and ventilation. The water is pumped from a spring to the mines, chiefly for ore washing. All the towns of the district are lighted from the same works, which also operates the Cripple Creek District Railway. Coal is brought to the works by railway; and all the storing and stoking is done mechanically, on the Babcock and Wilcox system. The present output is 1000-horse power. Ingersoll-Sergeant air compressors are in use; and the mains are kept charged at 100 lbs. pressure.

Coke-Breeze Concrete Slabs.

It is reported that a new form of coke-breeze concrete, known by the trade name of "gypsine," has passed a satisfactory test at the station of the British Fire Prevention Committee. The material is a mixture of plastic hydraulic lime with coke and asbestos. For the purpose of fire testing, it was moulded into bricks; and a partition was made of these laid in hydraulic mortar—the joints being ¼ inch thick. On the side exposed to fire, the partition was coated with a thin layer of fire-clay. The area exposed to the flames was 7 ft. 9 in. by 10 ft.; and the heat was maintained for an hour. The temperature inside the test hut reached the maximum of 2050° Fahr. The partition proved impervious to the flames; and at no time during the test did the temperature of the outside surface of the partition become sufficiently high to ignite a match. While on this subject, it may be mentioned that a correspondent of the "Builder" recently urged that contractors (or gas-works) might do worse than stock for sale 2½ inch coke-breeze concrete slabs. The reason is that, owing to the length of time (not less than a month) that such concrete requires to be left to dry before flooring boards can be nailed down to it, architects are often obliged to forego its advantages for hurried work. It is accordingly suggested that the stocking of such slabs, of about the size of paving stones, would be profitable and convenient. Mr. Frank Caws, in a paper published in the "Journal of the Royal Institute of British Architects," indirectly supports the same suggestion by laying it down as essential that concrete used in building construction should remain undisturbed on the centering for six weeks. These slabs would, of course, be reinforced by expanded metal or its equivalent. For courtelages and ground floors, Mr. Caws recommends a surface coating of fine crushed granite, without sand, gauged 3 to 1. If gauged richer, the rendering is apt to show fine cracks on the surface.

Glass-Lined Water-Pipes.—In making repairs recently upon the interior of a dwelling-house in Boston (U.S.A.), the discovery was made that the water-pipes were lined with glass. The house was built some sixty years ago; and when Cochituate water was introduced into Boston, the owner of the house, with hundreds of others, became panic-stricken at the possibility of lead poisoning, and had all the pipes used in bringing city water into his house lined with glass. The experiment is said to have been unsatisfactory.

The Maintenance of Vitrified Clay Water-Mains.—We learn from the report of the City Engineer of Little Falls (N.Y.), that the vitrified clay water-pipe, which was constructed in 1886-7 at a cost of $45,544, has been very expensive to maintain. The pipe has a length of 5·63 miles, and the annual cost of its maintenance has been as follows: 1887, $962; 1888, $2103; 1889, $554; 1890, $81; 1891, $1174; 1892, $185; 1893, $492; 1894, $5790; 1895, $3888; 1896, $926; 1897, $24; and 1898, $8—making a total of about $16,187. During 1899, something like $1800 more was spent in cementing cracked lengths and in replacing 338 feet of the line with cast-iron pipe.

TECHNICAL RECORD.

WESTERN (U.S.A.) GAS ASSOCIATION.

Annual Meeting in Chicago.

The Twenty-third Annual Meeting of this Association was held at the Auditorium Hotel, Chicago, on the 16th, 17th, and 18th ult; and the President, Mr. W. M'Donald, of New Albany (N.Y.), guided the deliberations of a very successful meeting. After the Association had been officially welcomed, he delivered an Inaugural Address. In commencing, he alluded to several matters pertaining to the position of the Association. Attention was next directed to the relation of capital to output, and to the importance of an accurately kept capital account, showing the actual structural value of the plant erected, and also to the need for a system of accounts that would enable gas managers to compare the actual cost of delivering gas at the consumer's meter, under varying circumstances. The general experience was a decreased use of gas for illumination by large consumers, and a decrease in the average consumption per meter; and this would tend to increase the cost of distribution. The gigantic gas war in New York was to be ascribed, he believed, to differences of opinion as to how much capital a given output of gas would stand. During the past few years, there had swept over the country an almost insane desire to secure gas plants and finance them. While this had been profitable to the financiers, it had, in many cases, proved advantageous to all concerned; and the gas business of the country had been largely increased by combinations of capital with good business methods. But no company should have more than a reasonable amount of water in its composition; and when one syndicate after another tried its hand at the watering process, might not the mixture get thin, and had it not done so in certain cases? With a constantly increasing capital, a decreasing output per meter, and determined efforts on the part of the public to control the price of gas, the question of capital as compared with output required careful consideration. He concluded by expressing confidence in the future of gas.

Mr. Howard C. Slater, of Milwaukee (Wis.), read a paper on "Regenerative Benches." The efficiency in the use of the heat transmitted through the walls of the retort was, other things being equal, highest with the greatest difference of temperature between the inside and outside of the retort. As the escaping products of combustion could be cooled to about 500° Fahr. without interfering with the efficiency of the draught, it was easy to see that there was a considerable quantity of heat available for returning into the setting. But whether the economy thus available was counterbalanced by the extra cost of recuperators, was a matter that must be decided by local conditions. According to papers read by Mr. G. Helps and by Mr. C. C. Carpenter, in England, it would seem that little or no benefit was derived from regeneration; and that equal or better results could be obtained if the secondary air supply was heated without utilizing the heat from the waste gases. These results were due to the cheaper construction of the parts for preheating the air as compared with recuperators, and possibly to getting a higher heat, and to more even distribution in the setting. But for this, he failed to see why recuperators should not show an advantage in the fuel account. The preheating of the primary air was somewhat open to question, on account of the use of steam under the grate to keep the clinker from agglomerating. The amount of steam used should be as little as possible, consistent with producing the desired result, as excess of steam tended to lower the temperature of combustion, and prejudiced the even diffusion of heat. The specific heat of steam was higher than that of other products of combustion. Therefore the loss by way of the chimney would be more, to say nothing of the heat rendered latent in the evaporation of water into steam. He preferred a water-pan under the bars, from which steam could be evaporated, to the injection of already formed steam, because by this means the supply was automatically adjusted to requirements. If the under side of the clinker became black, less water would be evaporated; and when it was red-hot, just after pricking out, the evaporation would be more rapid. The quantity of water evaporated would be about 30 lbs. per 100 lbs. of coke used in the furnace. Attention was drawn to the effect of the varying quantities of moisture present in the atmosphere, according to the weather, which might affect the quantity of steam passed into the furnace to the extent of 12 per cent.

Discussion being invited, Mr. Odiorne referred to his experiences with half-depth furnaces, using slag or dump from the coal mines, which formerly could be had for hauling, but was now charged at 1d. per bushel. The cost of firing with coke for 24 hours was 12s. 3d.; the quantity used being 61 bushels. Firing with slag, 46 bushels were required, which cost 3s. 10d., showing 8s. 5d. saving as compared with coke. The furnace and setting had been used over two years, and therefore did not give such good results as when new. The make of gas per bed of six retorts was 42,700 cubic feet, or just over 7100 cubic feet per retort. Mr. Doty alluded to the introduction of mechanical stokers for bench-firing as a great advance, and would like some information about them. Mr. Egner thought the quantity of water evaporated was about twice as much as necessary, and that better results could be secured by reducing it. Mr. Forstall was aware that the English gas engineers had spent 15 or 20 years discussing the question, and were not yet decided whether regeneration paid or not. Theoretically, with a bench of sixes carbonizing 2000 lbs. of coal per retort per 24 hours, the effect of reducing the waste gases to 500° or so, and returning the heat so recovered to the setting, should be a saving of 400 lbs. of coke per day. From this data, it was possible to calculate how much it was worth while to spend upon regenerators. Another point not very much considered was the setting itself. The advantages of generators and recuperators might be lost by a poor setting. He knew of a case where the consumption of coke was reduced from 24 per cent. of the coke made to 19 per cent., merely by improving the setting. The best way to run regenerators was by frequent analyses of the gases; but where this was impracticable, a rough-and-ready test could be taken. Select a point close to the take-off, and commence with a short supply of air, when the blue carbonic oxide flame would be visible. Gradually and carefully increase the secondary air supply until the flame disappears; thus arriving at a point when combustion is complete without any great excess of air. He preferred a slight excess rather than a deficiency of air. Examination of the regenerator for leakages of air should be made every few days; and the average stoker could readily be taught to detect and repair such leaks. The carbonic oxide flame was not visible at a high temperature; but if it could not be observed at the take-off, for this reason there was something very wrong with the setting. Mr. W. E. Steinwedell said there were at least three things to be considered in working regenerator benches. These were the loss of draught in the bench, as shown by comparing the draught at the grate-bar inlet with that at the inlet to the chimney; the analysis of the producer gases and of the waste gases; and the consumption of coke. If these things are regularly determined, leakages into the chimney will soon be detected, and good results would be obtained. The analysis of flue gases for carbonic acid was a simple operation that could be conducted by the average retort-house foreman. Where the flue outlets ran into one large main flue, it was easy, by looking into one end, to observe the condition of things at the outlet from each furnace. Mr. Doherty agreed that the analysis of flue gases for carbonic acid, or testing for leakages, was quite within the capacity of the average workman. He was sorry to perceive an impression that the regenerator was not a source of economy. Fuel must be very cheap indeed where it could be dispensed with, without loss. By its means, the flame temperature and the yield per retort were increased. It had been stated that 500° was necessary to maintain the natural draught; but he questioned whether 300° would not be sufficient. Even at that, it might pay to adopt mechanical draught if the temperature below 300° could be utilized. The initial temperature of the air, and also the proportion of water vapour present, had a marked effect. Very different conditions prevailed in boiler firing to those in the retort-bench; and he thought that with the latter the best results were obtained with a carefully adjusted secondary air supply. The products of combustion escaped from the boiler setting at a lower temperature. He would like to see a Committee appointed to devise some simple means of testing flue gases. Mr. Norris remarked that the full economy of the whole depth regenerator was not realized unless it was kept in active work. Mr. Mitchell said that one simple test was to inject air through a small tube into the bottom flue, when the presence of unconsumed carbonic oxide would be apparent by the appearance of the blue flame at the end of the tube. He was able to adjust the air supply very closely by this method. He used a mechanical stoker, comprising a hopper and a screw at the base; the fuel being coal slack. The screw was run at 2½ revolutions per minute; and he used about a ton of fuel per 24 hours (the cost being 6s. 8d. per ton), and got as good results as were formerly obtained from the best lump coal. Mr. Somerville suggested the desirability of some experiments with artificial draught.

Mr. Slater, in replying, said that his consumption of coke was 23 per cent. of the coke made, using full depth beds with nine retorts in each. He had tried the American under-feed stoker; but it caused difficulty through accumulation of large blocks in the furnace. This was with a fuel composed of one part slag coal to two of breeze; and if a larger proportion of breeze had been used, there would have been less trouble. He did not see how the use of the mechanical stoker could affect the character of the flame; but some change in the arrangement of the primary air supply was desirable when this appliance was introduced.

Mr. Fred. H. Shelton opened a discussion on high-pressure distribution by stating that at the last meeting of the Association he read a paper on this subject, which practically propounded the question—Why not distribute gas at high pressure? Since that time, he had demonstrated that gas could be distributed at 100 or even 200 times the usual pressures, with efficiency and economy as compared with the old plan. The system had been described in a paper read at the last meeting of the New England Association, entitled "Pumping Gas Five Miles at 20 lbs. Pressure." This was done through a 3-inch wrought-iron pipe, tested up to 60 lbs., and well screwed together and coated. At the end of the pipe was a regulator that reduced the pressure to 20-10ths or 30-10ths of water at a single step; and after a little difficulty in adjusting at first, its action was absolutely perfect. He would not hesitate to leave it for a month; but a duplicate was provided in case of breakdown. From the regulator, the gas was passed into the delivery mains without any

holder intervening. No tests had been made to ascertain loss of candle power; but for all practical purposes the gas was not affected either in cold or warm weather. The pumps had given no trouble; and he had not experienced any of the troubles predicted. The system was started in December last, and proved so satisfactory that he was now going ahead largely in high-pressure distribution, and did not hesitate to connect services direct to the high-pressure pipes. Obviously it would never do to run the risk of high-pressure gas getting into an ordinary tin-case meter; but a very simple safety device, costing only 2s., was in the market, that would prevent such an occurrence. If the high pressure by any mischance got into the service, it automatically opened a relief valve connected with the exterior of the premises. Wrought iron was the only pipe available for high pressure, as he did not know of any joint that would make cast-iron pipe available; and as to durability, it was a simple matter to lay wrought-iron pipe in such a manner that it would be as durable as cast iron, as the natural gas people had proved. Cast iron might be made available by surrounding each joint with a gas-tight bandage or sleeve. As it was a new departure, he put tees with plugs at frequent intervals; but as a matter of fact, it was only necessary to attach drip-boxes to the first 3000 feet, as no condensation was found beyond the first 1000 cubic feet. Mr. Highlands said that, having found the consumption increasing beyond the capacity of the mains, and that in October last the pressure frequently fell as low as one inch at the centre of the district, he had tried the plan of increasing the initial outlet pressure at the works with the aid of a high-speed blower. The largest holder only gave 3 inches; but by this means he secured 7 to 8 inches. The system had been in operation for six months, and was a great success. It doubled the capacity of the mains, increased the output 25 per cent. without increasing the leakage, and had relieved him of the necessity for enlarging the mains. Mr. Doherty went with Mr. Shelton to some extent; but could not entirely accept the high-pressure system as a solution of distributing difficulties. He still feared depreciation of illuminating power; and a very important factor in regard to this was the increased velocity of gas in the pipes, which, so far as he knew, had not been considered. He believed in a combined system of high and low pressures, and that at high pressures the delivery was greater than would be indicated by the accepted formula. Mr. Evans had delivered gas to a holder nearly five miles distant through an 8-inch pipe, under an initial pressure of 10 lbs., passing nearly 70,000 cubic feet of gas per hour. This was water gas; and there was some deposition of hydrocarbons—about ¼ barrel of oil being pumped out of the holder-drips daily. Mr. Forstall understood Mr. Shelton to claim that high pressure distribution was economical; but there was no evidence, in the way of photometrical tests, as to the gas at the far end. Mr. Britton had worked a high-pressure pipe line, 8 miles long, for the last ten years. The average pressure was 5 lbs. There was no appreciable loss by leakage, or of illuminating power, as proved by photometrical tests. Mr. D. M'Donald spoke of the durability of wrought-iron pipe laid in clay; but, of course, it would corrode in alkaline soils. He also said it was less liable to be injured by electrolysis, as there was not the break in resistance at each joint that was a feature of cast-iron pipe.

Mr. W. H. Barthold, of Grand Rapids (Mich.), read a paper on "Temperatures in Condensation," illustrated by a chart prepared from the daily records at his own works, on which was also marked the time occupied by the gas in travelling from point to point as calculated on a make of 580,000 cubic feet per day. During the cold months, exhaust steam was admitted at the inlet of the purifiers to supply moisture and heat to the oxide. At a point on the standpipe 10 feet from the retort, the average temperature is 412°, and the time 2 seconds after leaving the retort. At the hydraulic outlet, after 18 seconds' travel, the average is 171°. He found that at this temperature hydraulic main tar exercised no solvent action on 14½ candle gas. But when the temperature was lowered to 110°, the gas lost 1½ candle power. At the inlet of the exhauster the temperature fell to 122°, and there was a steady fall in passing the condensers to 74°. A rise of a few degrees was observed in passing the scrubbers; and when steam was used at the purifier inlet, the temperature rose to 114°, falling steadily to 72° at the outlet of the purifiers. The whole journey to the purifier outlet occupied 10 minutes, of which three-fourths of a minute was spent between the retort and the exhauster, two minutes in the condensers, a similar period in the scrubbers, and the rest in the purifiers. Anti-dip valves were used; and the tar was drawn off from the foul main at frequent intervals, as he believed that prolonged contact of gas with the tar at that point was objectionable. At the inlet of No. 1 condenser, the temperature being 114°, a gallon of naphtha (specific gravity 740) to every 10,000 or 12,000 cubic cubic feet of gas was admitted. All this was vaporized; but if any excess was observed at the next drip, the quantity was diminished. The naphtha was capable of dissolving a little over half its weight of naphthalene, which condensed in the last condenser. He did not object to encourage the precipitation of naphthalene at this point by the use of cold water, because if it went on further, it gave trouble. In the winter, with a make of 630,000 cubic feet per day, he would get a barrel of naphtha saturated with naphthalene in a week; and there was no appreciable loss of candle power. In concluding, he questioned whether sufficient time was allowed for the condensing operations, and enlarged on the necessity for systematic reading of temperatures throughout, as without this there could not be uniform working.

Mr. Eysenbach opened the discussion by emphasizing the importance of a close watch over the temperature records; and advised that every drip should be so arranged as to show the flow of liquid from it. By watching this, it was possible to gauge the working closely. Mr. Highland said that his temperatures were similar to those quoted, except in the stand pipes, where they averaged 700° to 950°. As he believed that trouble from pitch did not arise below 550°, he would like to know how the author got down to 412°. Mr. Norris imagined that water gas was less likely to be injured by low temperatures or sudden changes than coal gas. He would also like to know the proportion of tar deposited at various parts. Out of a make of (say) 12 gallons per ton, what proportion came from the hydraulic, what from the Pelouze and Audouin condenser, and so on. Mr. Thwing referred to some experiments he had made at St. Louis, in conjunction with Mr. Chollar, on the rate of cooling or loss of temperature in the water-tube condenser, by means of thermometers fixed at intervals one foot apart. In the course of 20 feet run, he found the temperature of the gas was reduced from 140° to about 70°. The condenser had a rated capacity of two millions; and he passed on an average 67,500 cubic feet of gas per hour. Thirty gallons of water were sufficient to cool 1000 cubic feet of gas; and he figured roughly that the water took up 15,000 to 16,000 heat units per 1000 cubic feet of gas. His experiments showed that the colder the water, and the more rapid the circulation, the greater the efficiency. Although he had only one condenser, he was never troubled with naphthalene; and he believed it was removed and carried away by the tar in the condenser. The water entered at 68°, and left at 135°; and he noticed that theoretically it did not absorb half the heat carried into the condenser by the gas. The remainder might be accounted for by heat rendered latent in the act of liquefaction, and by radiation from the outside shell of the condenser. The liquids that drained off from the condenser had entered it as vapours. There was a certain excess of naphthalene that must be deposited somewhere; and he believed the best place was the condenser, where it would give no trouble. Mr. Chollar remarked that the experiments showed that the ordinary construction of water-tube condenser had too large an area for the water, and that with a quicker flow better results would follow. At another works, he had found that practically all the work was done in one-third of the condenser just below the middle, so a better form would be a smaller apparatus with fewer water tubes. The apparatus he used was 9 feet diameter, and had 600 2-inch tubes; so the water was several hours travelling through, while the gas went through in a few minutes. At another works, he obtained excellent results by using the same water over and over again, cooling it with an air blast. He could thus regulate the temperature at the water inlet, instead of having it vary with the climate. Mr. Forstall agreed that the construction of condensers was wrong. There was no better way of spoiling the candle power of the gas than by taking it to the top of a condenser 20 to 30 feet high, and letting it descend; cooling it down 50° to 60° in the course of its travel. According to Mr. Chollar, it might drop 60° in 7 feet or 8 feet, which was fairly rapid chilling. The author had shown that tar below 170° would take out nearly 2-candle power; and if the products of condensation descended to the cold end of the condenser with the gas, they would take out illuminants that would otherwise stay in. The tall tower condensers were cheap; but he believed in the horizontal condenser, with the water running up and down alternately through different sets of tubes.

Mr. Barthold, in replying, said that he used no special means to reduce the temperature of the gas in his standpipes. Although 700° to 800° in the mouthpiece, it came down to 412° after travelling through only 10 feet of pipe. He took out 2·6 gallons of tar in the hydraulic; and the remainder (he made 13 gallons per ton of coal carbonized) was dealt with by the Pelouze and Audouin condenser.

(To be continued.)

The Committee on Patent Office Reform.—"The Times" understands that the Committee, of which Mr. Hopwood is Chairman, appointed by the Board of Trade to consider the various suggestions for developing the benefits afforded by the Patent Office to inventors, have presented their report, which has been laid on the table of the House of Commons, and will be published in the course of a few days. The Committee recommend that classified illustrated abridgments of all specifications from 1617 to 1883 should be made, and the work completed by the end of 1906; that volumes of collected abridgments for each of a limited number of leading subjects of invention should be placed in the Patent Office as an experiment; that no action should be taken as regards the issue of reminders for payments of patent renewal fees; that authority should be given to the Comptroller-General to reprint specifications of expired patents for which there is a demand; that a system of deposit accounts for Patent Office publications should be experimentally adopted; that the annual allowance for the purchase of books and for binding for the Patent Office library should be increased for the next three years; and that a special sum should be allowed for the purchase of books already selected, but which cannot be supplied for want of funds.

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

The Fifth Annual General Meeting of this Association was held at Cardiff last week—the proceedings commencing on Tuesday morning with a reception in the Town Hall by the Mayor (Mr. S. A. Brain, J.P.). Considering the distance and awkwardness of the railway journey for many of the members, there was a very fair attendance, though some faces one has become accustomed to see at the meetings were missing. However, several local gentlemen, and a few of the members' friends, supplemented the number; and by the time they met in the Council Chamber, at the desire of the Mayor, there was a very respectable assembly.

His Worship's Reception.

The Mayor, who was heartily greeted, said it gave him great pleasure to welcome the Association to the town; and he hoped the reception the members would get would come up to their expectations. Cardiff was always prepared to welcome and entertain members of the great Associations of the country. Meetings of this description, where opportunities were afforded for the interchange of ideas, were bound to result beneficially to the community. Water engineers had contributed much to the health and happiness of the people; and the decided diminution of the death-rate, though assisted by more sanitary dwellings and improved conditions of living among the working classes, was in great measure due to the liberal supply of pure water. So far as Cardiff was concerned, its people owed a deep debt of gratitude to those whose foresight, enterprise, and skill had arranged their great water-works undertaking, which, he was proud to say, gave Cardiff an ample supply of water not bettered in any town in the country. He hoped their visitors would go away with the idea that, although Cardiffians practically existed on coal, and the neighbourhood was rich in the mining industry, they were still a very intelligent and a very civilized people, and that they were only too anxious to extend to such Associations as the Water-Works Engineers the hospitality which was their due.

Mr. William Watts (Sheffield), the retiring President, heartily thanked the Mayor for his official recognition of the Association.

The Business Meetings.

The members then adjourned to the South Wales Institute of Engineers, where the business meetings were held. Mr. Watts presided during the transaction of the formal business.

The minutes of the last meeting having been presented by the Secretary (Mr. Percy Griffith), and confirmed by the members,

Mr. Watts, in a few complimentary terms, introduced his successor in the chair, Mr. C. H. Priestley, Assoc.M.Inst.C.E., the Water Engineer to the Cardiff Corporation.

The President, who was greeted very cordially, paid a tribute to the able manner in which Mr. Watts had discharged his duties, and moved that the best thanks of the members be accorded to him.

Mr. William Matthews (Southampton) seconded the motion, which was carried by acclamation.

The President then proceeded to deliver his

INAUGURAL ADDRESS.

The address commenced in the orthodox manner—with the President's expression of thanks for his election. A hope that the Association would increase in usefulness and numbers lead to the remark that young societies such as this have generally much uphill work during the first years of existence; and therefore it is the duty of all members to do their utmost to aid the Council by every means in their power. However, there is fairly good reason for congratulation, seeing that the roll now numbers 220, although it is not five years since the preliminary meeting was held at Nottingham, at which it was decided to form the Association. A paragraph was devoted to some thoughts on the value to engineers of visits to works in course of construction; and in this regard, by the way, the fortunate situation of the President had enabled him to draw up a splendid programme for the present meeting.

A review of the progress made in the water supply of the country followed; and some historical information was given. Coming down to the construction of the extensive and varied works which have occupied the attention of many of our leading engineers during the last half century, the President gave prominence to the names of Thomas Hawksley and Frederick Bateman, who, he remarked, may be said to have been foremost among the engineers who have carried out the many large schemes of water supply which have been constructed since 1850, and who may, perhaps, be looked upon as the pioneers of water engineering as now understood in this country, more especially with regard to the gravitation supplies. The extensive works which the Glasgow, Liverpool, Manchester, and Birmingham Corporations have constructed or have in progress were mentioned. Besides these, most important and extensive schemes have been carried out during the past fifty years by nearly every large town and many of the smaller municipalities and villages throughout the country; the capital expenditure on municipal water-works alone now standing at the enormous total of £48,434,000 sterling, in addition to upwards of £5,000,000 of borrowed capital paid off. It may be interesting to note that out of 64 county boroughs in England and Wales, the water supply is under public control in all but 19; and of the remaining 141 boroughs, other than county boroughs, 139 have municipal supplies. About half the urban districts, too, are supplied with municipal water. These particulars, the President observed, are not given as in any way reflecting upon the water companies, who have done good work in the past in many places, and are still doing so in many others, but as showing how the municipalities and district councils generally have within recent years been alive to the provision of suitable water for the populations under their care. No doubt much more remains to be done, especially in the smaller towns, villages, and sparsely populated districts; but personally the President has no fear but that the time is not far distant when everyone in this country will have that most excellent of all good things—a supply of pure water sufficient for all ordinary requirements.

The succeeding portion of the address presented a general sketch of the scheme of Sir Alexander Binnie for supplying London with water from Wales, which scheme, if ever carried out, would be the most gigantic water undertaking in the country. Pursuing this subject, the President said: I believe that, when the necessity for the supply does come, as it undoubtedly will some day, if London goes on increasing in population as it has done for many years past, it will be rather to the advantage of Wales than otherwise, always assuming that due regard is given to the requirements of the districts from which the water is drawn, and that they are fairly and liberally dealt with. There is no doubt that at the present time very large quantities of water (sufficient to supply an enormous population) simply run to waste; and I see no reason why this water should not be profitably used either in London or elsewhere so long as it is not needed or likely to be needed in the district where it falls. But here I should like to point out that in the Bills which have been promoted before Parliament by the London County Council, there has been no adequate provision for the districts from which it was proposed to draw the water. Section 21 of the last Bill provided for compensation water to the several rivers amounting in the aggregate to over 60 million gallons per 24 hours. Section 24, which dealt with the supply of water to the county councils and other authorities, was as follows: "It shall be lawful for the Council on the one hand, and any county council, urban or rural district council, highway or other local authority, and any corporation body or persons within the counties mentioned in this Act on the other hand, to enter into and carry into effect contracts for the supply of water in bulk or otherwise." From a careful reading of this section, it will be seen that no provision whatever is made by the Bill for the compulsory supply of any district from which water is taken by the intended works, or through which such works will be constructed. The question of supply is entirely optional with the County Council and any other body. If any district requires a supply of water, the County Council would not be bound as to the price to be charged for it. In all future Acts of Parliament authorizing the abstraction of water from the districts situate at long distances from places where the water is to be used, I would make it compulsory upon the undertakers that proper provision should be made for supplying the district in the watershed, which has a prior right to the water from the works or mains at a reasonable price, to be fixed by arbitration, failing agreement.

The increased use of water for all purposes makes it more difficult to meet the needs of our growing populations; and the President has no doubt it is the experience of water engineers and managers throughout the kingdom that what was considered an ample domestic supply 20 or 25 years ago is now quite insufficient to meet modern requirements. The introduction of a variety of new purposes (public and private) for which water is required has helped to make the total consumption per head of the population very much greater than it was a few years ago; but it is often difficult to convince water committees, directors, and consumers generally that this is the case. The use of water for trade purposes purely is also much greater than formerly; but as this is generally measured by meter, the increase can be more easily accounted for. In stating this, the President assured his auditors that he was not advocating that restrictions should be placed on the legitimate use of water in any of the above ways, believing as he does that the health and happiness of the people, especially those living in large centres of population, is increased thereby.

Speaking next of hydraulic power, the President remarked that during the last few years there has been a demand, especially in the larger towns, for high-pressure water to be supplied for many purposes in connection with business premises, public buildings, churches, hotels, &c. This branch of water supply will, no doubt, in his opinion, be largely developed in the future, especially so where a number of consumers can be found within a reasonable area. Even in domestic life, if water power can be supplied at a cheap rate, considerable saving in time and labour may be brought about; and for small works and industries that require power during perhaps a few hours of the day only, water motors driven from the hydraulic mains should prove very useful and economical.

In connection with the provision of water to the larger towns of the country, it has often occurred to the President whether a duplicate supply might not in many cases be more economical.

Much of the water, as previously mentioned, is used for purposes which do not require it to be absolutely pure, such as should be always supplied for drinking and dietetic use. He believes there are duplicate supplies to some extent in one or two towns in the North of England. Where a number of trades and manufactories are near together, they are supplied from what is called a trade main, the water in which is not filtered; and there must be many towns situate near to rivers from which water could be easily drawn, and also near to gathering-grounds or other sources that do not perhaps give off water suitable for drinking, but which could be advantageously used for trade and municipal purposes. This water could probably often be supplied at a profit to the undertakers for a much less price than water derived from long distances where costly works had to be constructed, or that had been treated by filtration to purify it. The great objection is, of course, the duplication of the water-mains throughout the streets, and the first cost of laying the second set of pipes from which the trade and municipal supply would have to be drawn. But even with this expenditure, he feels convinced that in many towns it might be cheaper than going long distances for a supply, in addition, perhaps, to the cost of increased filter-beds, &c. Another great advantage would be that the gathering-grounds from which the best water could be drawn would be longer preserved, and might be available for districts where it was more urgently required.

The next question to which attention was called was that of standard patterns in connection with the use and manufacture of cast-iron pipes. It is, said the President, no doubt well known to the members that cast-iron pipes manufactured in America have been and are being used in Great Britain, even in Glasgow, one of the chief centres of the pipe industry of the kingdom. It may not be so well known that these American manufacturers will in no case, he believes, conform to the specifications and drawings of the English engineers, but will only supply pipes made to their own patterns—guaranteeing, of course, that they will stand any required pressure and submitting the same to an inspector, who may, if thought desirable, be appointed in England and sent out to the States. They have standard patterns which are in general use for all sizes of ordinary straight pipes from 2 to 60 inches diameter, and also for a large number of special castings, such as bends, branches, tees, &c. On visiting the pipe foundries in England, one is surprised to see the very large number of patterns in the shops for the same size pipes; many of the divergencies being trifling in character and of little practical utility. But still the manufacturer is bound to make his pipes in accordance with the drawings which may be supplied, even if the order be for only a few tons of (say) 4-inch or 6-inch pipes. The President is informed by large manufacturers that one of the difficulties they have to contend with is the great diversity of patterns in use by waterworks engineers and managers throughout the country—thus practically precluding them from keeping a large stock of pipes; whereas if some standard patterns could be adopted by general consent, especially in pipes up to 12 or 18 inches diameter, a great saving in plant would ensue. The manufacturer in slack times, and when materials were low in price, would be able to make pipes to keep in stock; being assured of a market for his goods when a rise took place. The advantages to engineers and consumers would also be very great. Instead of having to wait often for months at a time before any large number of pipes could be delivered, the manufacturer would be able to draw upon his stock, and also to combine with other makers in case of very big orders, knowing that the pipes would all be of the same pattern. Thus the delay in delivery might be obviated to a great extent, more regular work provided for the men, and probably a steadier market generally maintained. Under the above conditions, there need be no fear of the pipes not being up to the required strength, as it would be possible to have them re-tested under the superintendence of an inspector before leaving the foundry. He suggests this matter to the Association as a practical question well worthy of their attention, as he feels assured that, if any considerable body of engineers in this country were able to agree to certain patterns which they would always use, the prices quoted for what might be looked upon as standard patterns would be gradually lowered so that in time they would really become the only patterns used.

The subject of Water Boards was the final topic dealt with. Upon it, the President said: As the members are aware, the question has been before the Association for some time past; a Water Boards Committee having been appointed in 1897. This Committee has met from time to time, and they have given very considerable thought and attention to the matter. It was hoped that a report might have been ready for presentation at this meeting; but the subject is so full of debatable matter, and the Committee were anxious to arrive at such conclusions as they hoped would be acceptable to the majority of the members, that they have been unavoidably obliged to postpone the presentation of the report, but expect to have it ready for the next winter meeting. I think we may congratulate ourselves upon the excellent attendance at our meeting on Feb. 17 last, when Mr. C. E. Jones read his paper on "The Nation's Water Supply, and Its Effective Control"—a paper which caused much discussion both among our own members and the large number of visitors and delegates who represented other Societies and Associations. It is very gratifying to know that since the above meeting one of the members of our Council has been appointed Engineer for the largest scheme to be carried out by a Joint Water Board in the kingdom. I refer, of course, to the Derwent Valley Board. The working of this Board, and the results obtained by an amalgamation of four large municipalities such as those of Leicester, Derby, Sheffield, and Nottingham, will no doubt be watched with the keenest interest; and upon the success or otherwise of this undertaking, I think very much will depend. It is, to a great extent, a new departure in the method of utilizing a watershed in this country, and I see no reason why it should not be a success, although no doubt much depends upon the members of the different Councils working harmoniously together, and helping their Engineer to overcome difficulties which may occur in the construction of the works and the general administration of the undertaking.

On the proposition of Mr. MATTHEWS, seconded by Mr. H. ASHTON HILL (Birmingham), the President was thanked for his address, which was characterized as "a remarkably able contribution to the records of the Association."

NEW MEMBERS AND ASSOCIATES.

The Scrutineers (Messrs. C. Sainty and J. Shaw) reported that the following new members and associates had been elected:

Members—Mr. Joseph Haynes, of Manchester, Mr. C. E. Newton, of Manchester, and Mr. G. B. Rawden, of Morley.

Associates—Mr. E. H. Coller, of Ipswich, Mr. A. H. C. Hines, of Cambridge, and Mr. J. Hopkinson, of Watford.

HOSPITALITY BY THE MAYOR.

At the close of the morning sitting, the Mayor entertained the members of the Association and the chief officials of the Corporation to a luncheon of a very liberal character in the Town Hall Assembly Rooms. His Worship presided; and his geniality and urbanity added considerably to the happiness of his guests. A short toast-list was gone through, in the course of which the Mayor was heartily thanked for his generosity.

Returning to the Engineers' Institute, there was a little time to spare before the members visited the Bute Docks and the Dowlais Iron and Steel Works; and the President usefully employed it by giving them an extempore account of

THE CARDIFF CORPORATION WATER-WORKS.

He said that as the result of the Public Health Act of 1848, an inquiry was held in Cardiff early in 1850 in regard to its sewerage and water supply. To those who were living in Cardiff fifty years after, the condition of things then existing appeared very strange. There were some wells in the town, one of which was at the corner of the High Street and Duke Street; and, in his evidence, a gentleman who lived at that spot stated that he had a cesspit in connection with his house which had not been cleaned out for two years. The well, which was 20 feet deep, was only situated 3 yards from the cesspit. This was the nature of the water supply prevalent in Cardiff at that time; and therefore it was not surprising to learn that there was a serious epidemic of cholera the previous year. In 1850, the Cardiff Water Company was started; and a year or so later, a supply of water was given. The pumping-station was constructed at Ely. In the first place, the water was taken from the river, and was roughly filtered through sand alongside it. The water was then pumped to a service reservoir at Penhill, and was distributed from there by gravitation to the town. For a considerable period after the works were first started, the people did not take to the water; they having been used to fetching it for themselves. But they gradually began to take the services into their houses. The population increasing very rapidly indeed, in a short time after—within ten years—it was found necessary by the Company to go further afield; and they then applied for additional powers in 1860. About that time, they built the Lisvane reservoir, with a capacity of 60 millions (afterwards increased to 80 millions), and a gathering-ground 2200 acres in extent. In 1879, the Corporation bought the works. The Company, finding their then supply quite insufficient, went to Parliament for powers to construct the Lisvane reservoir No. 2, and for a high-level service reservoir. The Corporation did not oppose the Bill; but they came to an arrangement with the Company to purchase the works, without going to arbitration. The sum of £300,000 was paid for the undertaking, or £320,000 including some stock the Company had at the time. It was decided, in the first place, to extend the works at Ely; but only a part of the project was carried out. Up to that time, Mr. Taylor had been Engineer; but, in 1881, the Borough Engineer (Mr. J. A. B. Williams) was instructed to inquire fully into the available water supplies for Cardiff. After some extensive investigation, and a report in favour of the Taff Fawr scheme, the Corporation decided to go for powers to impound the waters of the River Taff Fawr in Breconshire. They obtained authority to construct three reservoirs and other auxiliary works. The watershed consisted of 10,400 acres, divided into two portions—the upper part 4000 acres, and the lower area 6400 acres. The Llanishen reservoir was first constructed; and its capacity was 317 million gallons. It was immediately found of great service; inasmuch as it was filled from the watershed during 1886, and was of immense assistance during the dry year of 1887. In addition to the works in the Taff Fawr Valley, sanction was obtained to make a high-level service

reservoir and filter-beds at Rhubina for the supply of the whole of the high-level district. Concurrently with the construction of No. 2, or Cantreff, reservoir, a pipe-line and balancing reservoirs were built. The pipe-line was 29 inches in diameter for a certain distance and 24 inches for the remainder. The culvert from Breconshire to Cardiff was over 30 miles in length; and it was capable of delivering 12 million gallons of water per day. In the construction of No. 2 reservoir, two contractors failed to carry it through; and then the Corporation took over the work themselves. Great difficulty was found, in constructing this reservoir, in getting a water-tight bed for the concrete shoe of the embankment on either side. The total length of the embankment was 600 feet, and there was at least about one-third more taken into the hillside, in order to get a water-tight foundation. From the completion of the reservoir in 1892 until the present time, water had been brought from Breconshire to Cardiff. Immediately on the completion of the Cantreff reservoir (which has a capacity of 322 million gallons), the extension of the town and the increase of the population being so great, Mr. Williams suggested to the Corporation the advisability of at once commencing No. 1 reservoir—that was, the top reservoir of all. This reservoir was constructed entirely by the Corporation; and it was opened in the autumn of 1897. The reservoir as first designed was not so large as at present; but its capacity is now actually 345 million gallons. The four reservoirs he had mentioned gave them, the President said, a total storage capacity of 1063 million gallons. Referring to the considerable quantity of compensation water the Corporation have to send down the river, the President made the interesting statement that a large iron-works situated at a point just above Merthyr Tydfil were kept going last year owing to the compensation water; while, on the other side of the river, the Dowlais works had to stop for several weeks. In a great many cases, it was an inestimable benefit rather than otherwise to a district to have reservoirs constructed in it. He was now about to report on the advisability of constructing the third reservoir, and this would take the lower drainage area of 6400 acres. It would about equal in capacity the two others together. From the reservoirs the pressure was broken in three places—at Cefn, Blackbrook, and Rhubina; the capacity of each of the balancing reservoirs at these places being a little above ½ million gallons. The top water-levels of these small reservoirs were 765, 490, and 330 feet above Ordnance datum, while the top bank level of No. 1 or top reservoir was 1346 feet. The President proceeded to give further information in regard to minor portions of the works, and the high-level supply.

Papers and Discussions.

Only Wednesday and Thursday mornings were devoted to the consideration and discussion of further technical matters. On the first-named day Mr. F. J. Bancroft (Hull) read a paper on the question of "The Rating of Water-Works;" and a very fruitful discussion ensued. Mr. Alfred J. Jenkins (formerly Assistant Water Engineer at Cardiff) followed with a paper on "The Relationship between the Cost of Water Wasted, and the Cost of Detection and Prevention of Waste." The discussion on the latter was postponed until after the delivery, on Thursday morning, of a lecture by Dr. A. C. Elliott, Professor of Engineering at the University College of South Wales (Cardiff), on "The Strength of Bricks and Brickwork." During the evening, some of the members accepted an invitation by Dr. Elliott to witness his demonstrations with a 100-ton testing-machine. The papers and discussions (which were very protracted) will be dealt with in succeeding issues of the "Journal." Descriptions of the Pontypridd and Rhondda Water-Works, specially prepared respectively by Mr. W. Jones and Mr. Octavius Thomas, were circulated among the members.

Votes of Thanks.

The discussions finished, several votes of thanks were passed, encompassing all who had in any way contributed to the interest or pleasure of the meeting. The authors of the papers and the lecturer were thanked, the handsome way in which the Mayor and Corporation had treated the members was acknowledged, and gratitude was expressed to the President and Council of the South Wales Institute of Engineers for their kindness in allowing the Association the use of their Lecture Theatre and rooms, and for their attention to the comfort of the visitors. The local gentlemen who had entered heartily into the making of arrangements for visits to works were the recipients of the members' best thanks, as were also the representatives of the works visited. Among other votes, cordial acknowledgment was made of the work of the Council and officers of the Association during the year.

The Winter Meeting.

An announcement by the President, that the winter meeting would be held in London in November next, concluded the business proceedings.

The Annual Dinner.

The annual dinner was a very successful and enjoyable feature of the week's doings. It took place on Wednesday evening; the Esplanade Hotel, Penarth—an extremely pretty outlying seaside resort of Cardiffians—being selected for the purpose. The choice was a good one; the dinner being well served, and the musical programme provided good. The President headed the table; and some of the gentlemen who were receiving the members at local works were his guests. A toast-list was gone through; the speeches being commendably short, and certain of them amusing.

Visits to Works, &c.

Cardiff being rich in works of that splendid character, extent, and repute which make them veritable mines of interest to the engineer, the President, with the kindly co-operation of other local gentlemen, constructed a programme of visits which were alone of sufficient technical interest to make the meeting a success. On Wednesday, by the kind permission of the Chief Agent of the Marquis of Bute (Sir W. T. Lewis, Bart.), they inspected the extensive Bute Docks of the Cardiff Railway Company—a special train being provided for the purpose. The heavy constructive work in progress in connection with expansive new docks was examined with very deep interest by those members who have to do with the design of reservoirs. *En route* a visit was paid to the Cardiff Dowlais Iron and Steel Works (including the rolling-mills); and by the considerate action of the General Manager (Mr. E. P. Martin), the members were enabled to watch some of the processes throughout. The metal, for instance, was seen flowing from the cupolas in liquid state, then formed into huge oblong blocks (still at almost white heat), and then converted, by the aid of the rolling-mills, into extensive sheets. On Thursday afternoon, in fair weather, the President gave the members a great treat. By breaks they were taken, through charming woodlands and valleys and over hills, to portions of the Corporation water-works. First they went to the Rhubina high-level supply works filter-beds, where they saw the open and covered service reservoirs in course of construction. It was observed that the work was of a particularly heavy nature on account of the rock deeply embedded in the soil, and all of which has to be removed by hand and trolley work. At this station a Venturi meter and diagrams were examined with much curiosity by several. The Llanishen and Lisvane storage reservoirs (capacity 400 million gallons, and the Heath filter-beds and service reservoir (six beds, calculated to filter a million gallons per day each) were visited. At the latter place, a Greenway sand-washing machine, made by Messrs. James Gibb and Co., of Fenchurch Street, was proving itself a useful apparatus, and its action commended itself to several of the members. A tintometer, by Negretti and Zambra, was also subjected to the tests and criticisms of the visitors. Very welcome, after the long drive, was the tea which the President, in his thoughtfulness, had arranged for at this station; and Mrs. Priestley and other ladies found as much delight in dispensing the refreshments as the visitors were grateful for them. The arrangements for Thursday afternoon included a visit to the Lewis Merthyr Collieries, one of the largest in the kingdom; and there a luncheon was provided. An alternative visit was to the Barry Docks, the Water-Works, &c.; and the greater number of members undertook this—the morning sitting having extended beyond the time appointed for the setting-out on the first-named excursion. A long expedition was mapped out for Friday—extending from 8.30 in the morning to 9 at night. The works arranged to be visited were the Upper Neuadd reservoir of the Merthyr Tydfil District Council, including the large masonry dam being constructed to the designs of Mr. G. F. Deacon. After noon the Taff Fawr works of the Cardiff Corporation were visited. Refreshed by luncheon at the Beacons reservior, an inspection of the structure was made. The Cantreff reservoir and the Cefn balancing reservoir were included in the excursion. Tea was taken at Merthyr Tydfil; and from thence the "trippers" returned direct to Cardiff. This concluded a programme which for completeness equalled, if it did not excel, any one of those prepared for previous meetings.

American Society of Civil Engineers.—The 32nd annual convention of this Society will be held at the Institution of Civil Engineers during the first week in July, under the presidency of Mr. John F. Wallace. One of the subjects to be discussed on the occasion will be the "Filtration of Water for Public Use." It will be introduced by Mr. Rudolph Hering, who will deal with the several processes now used for the removal of objectionable matter, and their comparative sanitary effect, cost, and reliability.

Scraping Water-Mains.—In a letter recently addressed to the Editor of the "Engineering Record," the City Engineer of Halifax, Nova Scotia (Mr. F. W. W. Doane), called attention to some passages in his last annual report furnishing particulars in regard to the scraping of his water-mains. Since 1880 he has been using a mechanical scraper. In 1884 his low-service 24-inch main, 13,400 feet long, was cleaned for $8·22, or 0·06c. per lineal foot; and in the following year the cleaning of the high-service 15-inch main, 29,628 feet in length, was done for $8·30, or 0·03c. per foot. Between 1882 and 1898, 160,800 feet of 24-inch pipe was cleaned for $167·30; 26,848 feet of 20-inch, for $36·67; 348,568 feet of 15-inch, for $204·44; 33,616 feet of 12-inch, for $793·01; 20,514 feet of 6-inch, for $1074·42; and 17,323 feet of 3-inch, for $558·56. The relatively high cost of cleaning much of the smaller pipe was due to the fact that the cleaning was done but once or twice during the period of years covered by the figures, and had to be carried out in many instances in sections only a few hundred feet long.

REGISTER OF PATENTS.

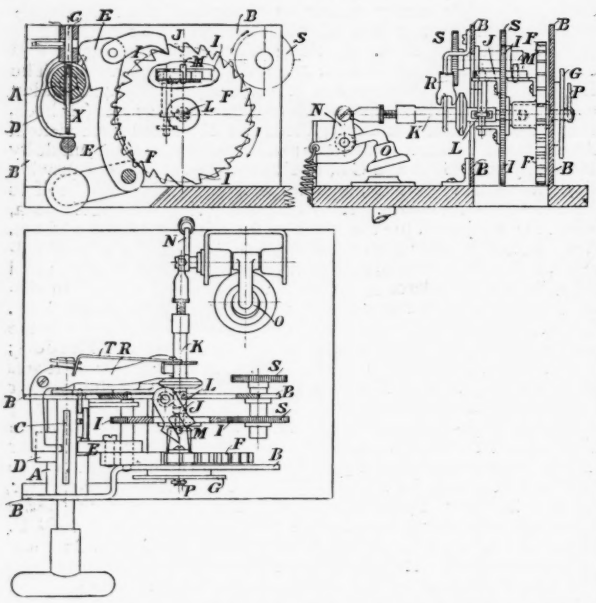
Manufacturing Gas for Motive, Heating, and Lighting Purposes.—Stewart-Wallace, J. S., of Belfast, Cowell, W. B., of Fulham, and Paisley, J. R., and Kemp-Welch, J. S., of Wandsworth. No. 10,983; May 25, 1899.

This invention relates to the manufacture of gas from substances of the hydrocarbon series, for motive, lighting, and heating purposes; and it has chiefly for its object "to so manufacture the gas that it shall be a permanent one, and capable of being used as the motive power for driving engines, without causing the carbonaceous deposit and other objectionable residues which have hitherto taken place in oil and gas engines, and greatly militated against their use."

The patentees propose to admit the hydrocarbon in regulated quantities to one or more retorts or chambers, adapted to be heated to a bright red heat, or to a temperature varying from (say) 1290° to 1470° Fahr.; and at the same time admit to the retorts a suitable quantity of atmospheric air, which commingles with the vapour or gas generated from the hydrocarbon in the retorts. The gaseous mixture is then conducted through suitable devices to eliminate the "aqueous and other objectionable matter" it may contain, and is then passed to a holder for storing, or led direct to the engine.

Coin-Freed Gas-Meters.—Beechey, C. G., and Wright, A. T., of Liverpool. No. 14,753; July 18, 1899.

This invention has reference to the class of gas or similar meters in which, by inserting a coin into the coin-carrier, and rotating it, mechanism will be actuated, which sets the meter (say, by opening a valve) to supply a quantity of gas of the value of the coin introduced; and when the gas so paid for has been consumed, the movement of the meter in passing the gas will work back certain parts, shut off the gas, and stop the meter.



A is the carrier, in the form of a small cylinder, mounted by a spindle at either end in the frame-plates B, and having a slot through it, into and through which the coins introduced into the meter pass. C is a slot or opening through the entrance-piece, into which the coins are placed when introducing them into the mechanism. D is a displacer bar, for moving the coin X when turned in its carrier. E is a lever or arm, the free end of which is disposed near the carrier-barrel A; the other end being mounted on a fulcrum. There is a counter-balance weight on the arm fulcrum, for bringing the arm E to its normal position—up against the carrier as shown; and there is also a pawl on E for actuating the ratchet-wheel F, for setting the meter. This ratchet-wheel revolves in the outer frame-plate B, and has attached to its outer end the dial G.

When a coin is introduced into the carrier, it rests on the lower end of the bar D; and when the carrier is revolved, the coin is pressed by the bar through the carrier-slot, and acts on the arm E, and moves the wheel F. The mechanism affected by the action of these parts, and that operated by the meter in passing gas, comprises: A tooth-wheel I, the spindle of which is mounted in the hub of the wheel F; an arm J, fixed on a spindle carried on the wheel I by brackets; a spindle K, connected with the gas-valve; and an arm L, engaging with the spindle K, by its end, which fits and works in a slot therein. The arm J works through an opening in the wheel I, as shown, and acts in conjunction with a pin M carried from the ratchet-wheel F by a bracket; and the shaft K is carried at one end loosely in the hub of the wheel I—the other end being attached to a lever N which operates the gas-supply valve controlled by the mechanism. This valve O is shown open in the drawing. The spindle of the wheel I is carried through the dial G, and at its outer end is furnished with a pointer P, which works in connection with the dial.

The action of these parts is this: Assuming the indicator on the dial to be at zero, and no gas has been paid for by the introduction of a coin, the arm J will be at one end of its stroke, and pressed up against the metal at the left-hand end of the slot. In this position the arm L will be at the inner end of its stroke, and have moved the shaft K towards the wheel I; closing the gas-valve O. In this position, no gas can pass. Then when a coin is introduced, and the ratchet-wheel F is moved in the manner referred to, the movement of the wheel will take the pin M away from the left-hand arm of the arm J. The result is that the spring, or the pressure of gas, will act upon the valve, pulling the shaft K longitudinally, and moving the arm L (by the metal at the end of its slot), and so, through the spindle, moving the arm J—that is, the arm will follow the pin M as it moves away from it. When the valve has been completely opened, the arm J will not move further. If, however, the spring could not remove the tappet, the pin M itself would come in contact with the right-hand arm of the arm, and move it into the position stated, and open the gas-valve.

By this movement of the wheel F, the dial connected with it will be shifted, and so indicate the amount of gas paid for. If further coins are introduced at this time, the wheel F is revolved, and the pin M will revolve with it, until the latter has made a complete revolution—viz., the wheel F has received movements equivalent to the pitches of its 24 teeth. When the pin has nearly completed this revolution, it acts upon the back of the arm J, and moves it still further; and so, through the arm L, further displaces the shaft K longitudinally. But, in so doing, a flange on the shaft comes up against the jaw of the bell-crank lever R, and moves the lever over. The opposite end of the lever at the same time pushes it across the slot C, and closes it so that no more coins can be introduced. The lever R being normally kept in position by a spring T, it will be seen that when the tappet J leaves the pin M (which it does when the meter supplies gas), the spring will, through the lever R, press the shaft K back into the normal position—that is, the position when the slot is open, as shown.

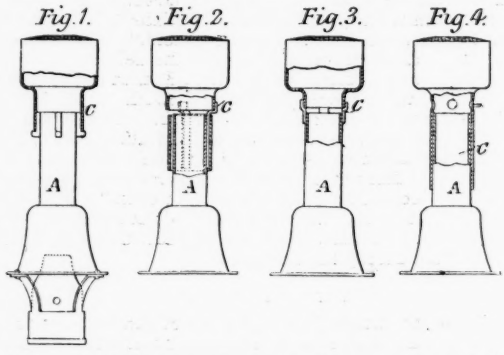
In the action of passing gas for which prepayment has been made, the wheel I is moved by a tooth-wheel S, and suitable gearing, driven by the meter—say, from the counting mechanism—and it is moved in the same direction as the ratchet-wheel F. And, as the arm J and arm L, and their spindle, are carried by this wheel, they move with it bodily, and therefore follow the pin M, which had been moved away from J in the prior action of the coin-operating mechanism. This also revolves the part of the shaft K with which the arm L is engaged; a suitable loose joint being provided to allow of this. As gas is consumed, the instant the wheel I begins to move, the indicator P, which is connected with it, will move over the dial in the opposite direction to that in which the dial is numbered towards zero. Then, when practically all the gas paid for has been consumed, the left-hand arm of the arm J will come in contact with the pin M (which will then be stationary), and so this tappet will be moved about its hinge, and be held; and as the wheel I revolves further, it will cause the shaft K, through the arm L, to be moved inwards and close the gas-valve.

Burners for Incandescence Gas Lighting.—Grautoff, A. H., of Jeffrey's Square, and Fritz, F., of Clifton Street, E.C. No. 15,119; July 22, 1899.

An important feature of the present invention is the provision for admitting an additional supply of air at or near the upper end of the tube or stem, to mingle with the mixture of air and combustible gas passing through, and "so producing a more complete admixture of air and gas."

Figs. 1 to 4 are sectional elevations illustrating different modes of carrying the invention into practice.

The air to be mixed with the gas in the tube A is admitted at the lower end of the tube as heretofore; but at the upper end an additional supply of air is admitted to mingle with the already mixed air and gas before



the latter passes into the burner-head. For this purpose, in fig. 1 the tube C carries the burner-head, and rests upon the upper end of A. It has a larger diameter than A; so that an annular space is provided between the two tubes, through which the additional supply of air enters. Ribs or projections keep the outer tube central on the tube A. In fig. 2, the tube C is made to slide up and down on A; the ribs (in this case secured to C) pressing with sufficient tightness on the inner tube to hold the outer tube in any position to which it may be set. The upper ends of the ribs are bent as shown to receive and grip the burner-head. The construction may be such that, on moving the tube C up or down, the opening for the supply of additional air may be regulated in accordance with the varying conditions of volume and pressure of the gas admitted. Where the pressure and volume of the gas is permanent, the burner-head may be fixed on the supporting stem, as shown in figs. 3 and 4. In fig. 3, the tube C is supported with its lower end some little distance above the end of the tube A; thus providing the required passage for the entrance of the additional supply of air. In fig. 4, the tube C fits closely upon the tube A, and is furnished with holes for admitting the additional supply of air.

Internal Combustion Motors.—Buchet, E. V., of Paris. No. 16,084; Aug. 5, 1899.

In internal combustion motors, as ordinarily constructed (says the patentee), the valve-casings for admission and exhaust are usually so arranged as to leave considerable waste space between the valve and the cylindrical explosion chamber. "This is one of the causes of low capacity of working, inasmuch as the motive fluid contained in this space does not contribute towards the propulsion of the piston, and not only does its

energy remain unutilized, but it exercises a very prejudicial action by the fact that it is transformed into heat passed into the walls of the cylinder, and that on this account these walls require energetic and constant cooling." According to this invention, the waste spaces are obviated by the peculiar arrangement of the admission and exhaust valves. They are disposed in the wall of the explosion chamber, in such a manner as to be flush with the internal surface of the wall.

Automatically Opening a Valve at a Predetermined Time.—Marks, C. C.; a communication from A. Stenhouse and E. Atkinson, of Broken Hill, New South Wales. No 25,443; Dec. 22, 1899.

This invention relates to apparatus of the kind described in patent No. 26,792 of 1898, "whereby a valve or the like is automatically operated to cut off, or turn on, a supply of fluid at any predetermined time or times." The object of the invention is to provide controlling gear and clockwork "alarum" or like apparatus which is constituted of fewer parts than the gear described in the earlier patent; much of the mechanism therein referred to being obviated without interfering with the effective working of the apparatus as a whole. The arrangement consists of gear driven by ordinary clockwork mechanism, whereby "alarum" or like mechanism is set free, or stopped, "to operate a valve or the like at any such time or times according to which an indicator on the gear is set."

Water-Meters.—Duncan, W., of Three Rivers, Quebec, Canada. No. 2288; Feb. 5, 1900.

The object of these "improvements in water-meters" is to provide a meter which is "far more sensitive than those now in use, and is also absolutely noiseless in its operations." It consists essentially of a main cylinder provided with a piston having its rod connected, by a suitable mechanism, to an ordinary meter-clock; a valve-piston cylinder having inlet and outlet ports; and a piston-valve located therein, and provided with ports, and having upward extending projection entering the main cylinder through a slot cut in its inner edge, whereby rotatory movement is conveyed to discs surrounded by, and supporting, a suitable ring with a slotted projection in its circumference. Means are provided for imparting rotatory motion to one or two of the discs, while a rod is connected at its upper end with an indicating clock, and at its lower end to a crank and crank-pin (the latter designed to fit into a hole in one or two of the discs to one side of the centre), so as to register the movements of the meter.

APPLICATIONS FOR LETTERS PATENT.

10,647-8.—Green, W. O., "Coin-freed gas meters." June 11.
10,698.—Du Bois, E., "Meter dials." June 12.
10,766.—Hamilton, J. H., "Gas-engines." June 13.
10,846.—Pollak, H., and Bartosch, F., "Incandescent gas-burners." June 14.
10,856.—Morgan, C. H., "Gas-engines." June 14.
10,859.—Mette, L., "Automatic gas-igniter." June 14.
10,861.—Bamberg, G., "Mantle for incandescent gas lighting." June 14.
10,881.—Burden, W. H., "Pressure-gauges." June 15.
10,993.—Haddan, R., "Gas-generators." A communication from the Adams and Westlake Company. June 16.
10,994.—Haddan, R., "Acetylene gas generators." A communication from the Adams and Westlake Company. June 16.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Carpenter-Brackenbury-Winstanley Controversy.

Sir,—The author of "Inclined Retorts at Bankside" having introduced into this discussion, by his letter which appeared in the "Journal" for the 29th ult., a personal element, both unwarrantable and erroneous, I have, of course, refrained from taking any further part in it. I should be glad, however—without, I trust, unduly intruding upon your valuable space—to express my acknowledgments to Mr. Frank Winstanley for his support; and, at the same time, I might state that I have not yet had the pleasure of making that gentleman's acquaintance, nor has any communication of any kind ever passed between us.

C. E. Brackenbury.

June 23, 1900.

The Gas Institute Amalgamation Discussion.

Sir,—In your report of the few observations I made on the subject of the proposed amalgamation, I am represented as saying: "It was on the trade question that the split took place." As a matter of fact, I expressed the opinion that "It was *not* on the trade question that the split took place."

James Stelfox.

Belfast, June 20, 1900.

Sir,—In reporting the discussion on the amalgamation of the Gas Institute with the Institution of Gas Engineers at last week's meeting of the Institute, my name appears in your issue of the 19th inst. as the seconder of Mr. Jones's amendment. This is doubtless a mistake on the part of your reporter. It was Mr. James Lees, of Tonbridge, who seconded the amendment.

Herbert Lees.

Hexham, June 21, 1900.

Mr. Edwards's Paper on Artificial Light.

Sir,—My attention has been called to an article in the "Journal" on the paper on "Artificial Light" which I read recently before the Birmingham Association of Mechanical Engineers. As you appear to doubt the accuracy of some parts of my paper, I should like, if you will allow me, to lay before your readers more clearly, some of the points you take objection to.

With regard to the illumination in a room painted white, as compared with that in a black room: I thought that the fact which I stated—viz., that, with a given source of light, there would be five times the illumination in the room in the former case, to what there would be in the latter—was common everyday knowledge to every lighting engineer. But such apparently, not being the case, I should like to try to prove it beyond the possibility of doubt. The "Law of Squares," as you call it, does not enter into the calculation at all. The distance between the lamp and the wall makes not the slightest difference, since the amount of light is not diminished, as you seem to think, by travelling across a room. The area of the surface to be lighted increases in proportion to the square of the distance from the light; while, on the other hand, the intensity of the illumination of the surface varies inversely as the square of the distance. In other words, although the intensity of the light on a surface becomes less the greater the distance, the area itself becomes greater in exactly the inverse proportion. To take an instance, the light reflected from a wall of 100 feet area, with the source of light at 10 feet distance, is exactly the same amount as would be reflected from a similar surface of 1 foot area at 1 foot distance from the same lamp.

In the particular case in question—the entire room being white—the whole of the rays of light from the lamp (except 20 per cent., which are absorbed) are reflected. These reflected rays are not in any way diminished by passing across the room to the other walls, which they strike, and 80 per cent. are again reflected. The process is continued, and the result is as previously stated. Whether we take mean spherical candle power, or not, does not make the least difference to the *proportion* of the increase of illumination from the white surfaces. I never suggested such a thing as "multiplying the initial illuminating power of a light." The source of light remains the same; but the illumination in the room is multiplied five times, owing to the illuminating power of the reflecting surfaces.

I cannot agree with you that the bottom 6 feet of a wall should be chocolate colour. You then lose the most valuable reflecting surface. With properly arranged lights, whether electric or gas, there is not the slightest necessity to have a "glare of light" even with white walls.

I cannot make sense of the statement that "the use of frosted glass is a barbarous *superstition*." Frosted glass or ribbed glass is used in the majority of engineers' shops for windows; and thus a serious loss of daylight is occasioned.

You have not read my paper very carefully, or you could hardly have said that I did not seem to appreciate the value of opal globes. I said: "It is better to use a globe if you wish to work immediately beneath the light; because, when no globe is used, the bracket casts the table into shade, whereas, with a globe, we get only 80 per cent. of the light, but it is diffused from the whole surface of the globe, and consequently there are no shadows underneath." Such criticisms are hardly just.

I should like to hear some good sound objections to horizontal burners, which you call "worse than barbarism."

With regard to incandescent gas lighting, you know (notwithstanding your remarks to the contrary), perhaps even better than I do, that there are many situations where incandescent gas lighting would be the most expensive system that could be adopted. The mantles will break; and to call this a "youthful weakness which the system will outgrow," does not affect the present cost of incandescent gas lighting.

I am sorry that the information on Dowson gas in incandescent burners was "vague," but I shall be pleased to supplement it if you will say what further information you require.

The cost of gas lighting as compared with electric lighting should have been 0·2d. per 16-candle power. This mistake was corrected in the first proof of the paper, a copy of which proof you seem to have. The figure (0·2d.) is certainly much nearer the actual cost of lighting by gas than the one you give, which is never touched in practice. The cost of electric energy which I gave, is taken from careful data collected during the actual running of the plant for twelve months. This plant is rather too large for its work, or the expenses would come out under 0.2d. per light.

A. E. A. Edwards.

Birmingham, June 18, 1900.

[We are pleased to hear from Mr. Edwards, and can assure him that it was far from our wish to criticize his paper otherwise than justly. Now that he has explained his views further, we can only remark that we cannot follow the reasoning of the first part of his letter, and must therefore let it pass. Why object to the use of the word "superstition" in the sense of something "standing over" and not needed? People who still use ground-glass partitions, do so because it has been customary, and because they have not troubled to find anything better. We fear it is Mr. Edwards, rather than we, who fails to understand the point of the remark about opal globes. Does he know what a "Christiania" globe is, and its use? Horizontally-disposed flat flames of gas flicker, smoke, and are wasteful, by reason of the excessive cooling effect of the air, and the necessity for a high pressure of gas if they are to be even approximately horizontal. The incandescent system of gas lighting is in its infancy in England. We repeat the charge of vagueness as regards Mr. Edwards's Dowson gas experiment. What is Dowson "water" gas? Does it differ from Dowson gas? What was the illuminating power of the carburetted gas? Were the same burner and the same mantle used throughout? Why was the gas carburetted to the amount stated? These queries do not exhaust the matter. If Mr. Edwards will repeat his experiments with all possible care and amplitude of data, we will gladly publish the results for him. Why is our statement of the cost of lighting by Birmingham gas never realized in practice? It is a simple matter of arithmetic.—Ed. J. G. L.]

Closing of the Kimbolton (Hunts.) Gas-Works.—The Directors of the Kimbolton Gas Company have given notice that they would cease to supply gas after the 24th inst., when the works would be closed. An effort was made to raise money by debentures to carry on the concern, but was not successful. A parish meeting has been held to consider if the Local Authority should be requested to purchase the concern, the price mentioned being £1000; but the proposal was negatived. The Company is an unlimited one.

PARLIAMENTARY INTELLIGENCE.

Gleanings from the Committee Rooms.

Only two or three Gas Bills are likely to come before second Committees of the Houses this session. Agreements and the satisfaction of opponents have almost completely cleared the lists; and the Bills are complacently moving on to the stage at which they will receive the dignity of the Royal Assent. The only measure in the gas line which is to be the subject of serious opposition is the famous Bill of the South Metropolitan Gas Company; and, beyond this, readers need not look for anything of an exciting nature from the Committee rooms during the remainder of the present session. In regard to the South Metropolitan Bill, we do not hesitate to say that some of the witnesses who supported the opposition with their names and position in the lower House would not be at all sorry to see the Bill go through now, if only, in their desire for knowledge, to see what will be the outcome in comparison with other companies working under the old conditions.

The first Bill to undergo a second investigation is the Morecambe District Council Bill; and it has passed through the ordeal unscathed. The inquiry on this occasion lasted two days before a Lords Committee. The purpose of the Bill, it will be recollected, is to obtain the endorsement of Parliament to the agreement which the District Council have entered into with the Morecambe Gas Company for the transfer of the works at a price of £141,000, which a loan of £9000 to be taken over, compensation, &c., will raise to £158,755. The only opponents were the Heysham District Council, who objected to the purchase on the ground that it would place them in an unfavourable position. The justification for the price to be paid will, in some measure, be found in Heysham. There are indications that in this direction, lies to large extent the prospective additional value of the concern. The extensive harbour which is being built there will make this hitherto sleepy district a centre of commercial activity; and the District Council's advisers have taken this into consideration in calculating the price that could be safely paid. When the provisional contract between the Morecambe authority and the Company was made, the Heysham Council suddenly awoke to the fact that some day they would possibly like to be their own suppliers of gas; and therefore they decided to oppose the Bill with the view of securing the insertion of the now almost obsolete "model" clause, which would have conferred on them the right to acquire the distributory plant in their area at its mere pipe value. This would have given them a power which they did not possess under the Company; and the Morecambe Council asked for nothing more than that the existing position of Heysham in regard to purchase should be maintained under the new *regime*. This was only just; and the Commons Committee before whom the Bill first came so recognized it, and rejected the petition of Heysham. To the Lords Committee the opponents preferred a similar request; but very properly with no greater success. Upon this failure, Counsel for Heysham sought to get the Glastonbury provisions of this session applied to the Bill (*ante*, pp. 875, 877); but the Committee refused to entertain them. The Bill will thus proceed; and in due course the works will be handed over to the new proprietors.

The evidence given last week was similar to that adduced in the Lower House. The expert witnesses engaged on the side of the promoters were Mr. Thomas Newbigging, Mr. Corbet Woodall, and Mr. E. H. Stevenson; and on the opposition side Mr. Arthur Silverthorne and Mr. Fletcher W. Stevenson were called. We heartily welcome the last-named gentleman as a professional combatant in the parliamentary arena.

HOUSE OF LORDS.

The following further progress has been made with Private Bills:—

Bills brought from the Commons, read the first time, and referred to the Examiners: British Gaslight Company (Staffordshire Potteries) Bill, Gaslight and Coke, Commercial Gas, and South Metropolitan Gas Companies Bill, Lambeth Water Bill, Mid-Kent Water Bill, Portland Urban District Gas Bill, Rickmansworth and Uxbridge Valley Water Bill, South Metropolitan Gas Bill, Wandsworth and Putney Gas Bill.

Bill read the first time and referred to the Examiners: Local Government Provisional Orders (Gas) Bill.

Bills read a second time and committed: Bradford Corporation Bill, East London Water Bill, Wolverhampton Gas Bill.

Bills reported: Huntingdon Corporation Bill, Walsall Corporation Bill, Water Orders Confirmation Bill.

Bills read the third time and passed: Bury and District Water (Transfer) Bill, Gas Orders Confirmation Bills (Nos. 1 and 2), Maidenhead Gas Bill, Ossett Corporation Gas Bill, Southport Water Bill, Walsall Corporation Bill.

The Examiners reported last Friday that the further Standing Orders applicable to the South Metropolitan Gas Bill had not been complied with. The matter will come before the Standing Orders Committee to-day.

The opposition to the North Warwickshire Water Bill has been withdrawn.

Petitions have been presented against the following Bills: East London Water Bill, South Metropolitan Gas Bill (from the Corporation of London), and Wandsworth and Putney Gas Bill (from the Wandsworth District Board of Works).

HOUSE OF COMMONS.

The following further progress has been made with Private Bills:—

Bills read the first time and referred to the Examiners: Bury and District Water (Transfer) Bill [Lords], Gas Orders Confirmation Bills (Nos. 1 and 2) [Lords], Salford Corporation Bill [Lords].

Bills read a second time and committed: Gas and Water Orders Confirmation Bill [Lords], Perth and Paisley Gas Provisional Orders Bill.

Bills reported, with amendments: Bristol Water Bill [Lords], Falkirk Corporation Bill [Lords], Gas and Water Orders Confirmation Bill [Lords], Gas Provisional Order (No. 3) Bill, Oldham Corporation Bill.

Bills read the third time and passed: British Gaslight Company (Staffordshire Potteries) Bill, Dorking Water Bill [Lords], Fishguard Water and Gas Bill [Lords], Gaslight and Coke, Commercial Gas, and South Metropolitan Gas Companies Bill, Great Berkhampstead Water Bill [Lords], Lambeth Water Bill, Menstone Water (Transfer) Bill [Lords], Mid-Kent Water Bill, Motherwell Water Bill [Lords], Mountain Ash Water Bill [Lords], Newtown and Llanllwchaiarn Urban District Gas Bill [Lords], Portland Urban District Gas Bill, Rickmansworth and Uxbridge Valley Water Bill, South Metropolitan Gas Bill, Wandsworth and Putney Gas Bill.

On Thursday, Mr. Pickersgill gave notice of the following question for last night: "To ask the Secretary of State for the Home Department whether his attention has been called to the fact that the Gaslight and Coke Company have just issued notices to their consumers raising the price of gas to 3s. 5d. per 1000 feet, and that these notices state that the enhanced price will be charged from the date of recording meter indices for the June quarter—the Company thus claiming to charge the enhanced rate for gas consumed during a week or ten days, or even longer, before the notices were served; and whether he will exercise the powers vested in him by section 45 of the Metropolis Gas Act, 1860, which (*inter alia*) provides that if it appears to the Secretary of State that a Metropolitan Gas Company is acting in a manner unauthorized by law, and it would be for the public advantage that the Gas Company should be restrained from so acting, he may set the Attorney-General in motion to take proceedings at law to restrain the wrongful action of the Company."

HOUSE OF LORDS COMMITTEE.

Tuesday, June 19.

(*Before the Earl of* Erne, *Chairman*, *Lord* Bagot, *Lord* Carysfort, *Lord* Erskine, *and Lord* Muncaster.)

MORECAMBE URBAN DISTRICT COUNCIL GAS BILL.

This Bill, which provides for the transfer of the undertaking of the Morecambe Gas and Light Company to the Urban District Council of Morecambe, came to-day before a Committee of the House of Lords constituted as above. The Bill had already been passed by a House of Commons Committee (*ante*, pp. 751, 808).

Mr. Balfour Browne, Q.C., and Mr. Honoratus Lloyd appeared for the promoters. Mr. Blennerhassett and Mr. Royds represented the Heysham Urban District Council; while Mr. Moon appeared on a petition against alterations presented by the Morecambe Gas Company.

Mr. Lloyd, in opening, said the Bill was to authorize the Morecambe Urban District Council to purchase the undertaking of the Morecambe Gas and Light Company, who supplied gas to both Morecambe and Heysham; the gas-works being situate in Morecambe. An agreement had been come to with the Company; and the only opposition arose from the Urban District Council of Heysham. When an urban district took over an undertaking such as this, and the Company supplied not only the district of the authority taking it over, but also an outside area, the invariable practice was to insert a clause enabling the outside authority to purchase their interest in the concern, if they desired to do so. Therefore clause 18 was inserted, to provide that, if the Heysham District Council desired at any time to sever and supply themselves, they could do so upon paying to Morecambe the fair value of that which they would get. Heysham, however, contended that they should be allowed to sever upon the terms of purchasing the pipes and apparatus in their district at "old-iron" price, or on the basis of structural value. Morecambe held that this would be obviously unfair, seeing that they would have had to pay the commercial value of these pipes and apparatus. There were a considerable number of precedents (40 or 50) in favour of clause 18 of the Bill; and some few (mostly inserted by agreement) in favour of the clause which Heysham desired. The Heysham petition pointed out that the Morecambe Council had agreed to purchase the concern for £141,000, which, together with a loan of £9000 (taken over), compensation, &c., would amount to £158,755. The Committee would hear from the Engineers representing the Council and the Company that this was a perfectly fair price; but Heysham held that the sum was enormously excessive, and out of all proportion to the value of the gas undertaking. It would not matter to Heysham if the price were excessive, because if they bought their portion of the concern they would only pay the fair value, and no part of the excessive value. Counsel added, in conclusion, that the Local Government Board had issued a report in which they made certain comments with reference to clause 18, which had been complied with; but they said nothing against the proposal of the promoters to allow Heysham to go out upon the terms of paying their fair share of the undertaking. There was no adverse comment in the report as to that; and no difficulty arose.

Mr. *T. Baxter*, examined by Mr. Balfour Browne, said he was Chairman of the Gas and Water Supply Committee of the Morecambe Urban District Council. He explained the steps leading up to the determination of the Council to buy the gas concern, and to the agreement for purchase which was arrived at on the recommendation of Mr. E. H. Stevenson and Mr. Newbigging. He held that Heysham, if they separated from Morecambe, should pay for their portion of the undertaking on the same basis as Morecambe was proposing to buy—namely, that of a commercial concern.

In cross-examination by Mr. Blennerhassett, witness said the Heysham Authority were not consulted when the agreement was entered into. The question of price had never been before the Morecambe people. Electricity had recently been introduced in Morecambe; and the supply, which was rapidly increasing, encouraged the consumption of gas.

Mr. *Thomas Newbigging*, examined by Mr. Lloyd, gave a number of details regarding the capital, powers of charge, &c., of the Company, showing that the concern was in an exceedingly prosperous condition. If the Company went on working, they would have had to raise the price of gas, just as the Council now would, having regard to the large increase in the cost of coal. Recently the Company had been able to

declare a dividend of 15¼ per cent. on the original stock, and of 12½ per cent. on the additional stock. This dividend seemed high; but it did not matter to the consumers, because the higher the dividend the greater the premium which could be obtained on the sale of shares or stock. The district was increasing very rapidly, with the result that the consumption of gas had doubled during the 3½ years to June, 1899—which was almost unprecedented. He knew of no other town in the kingdom where there had been a similar increase. The year 1899 showed an increase over 1898 of 29·18 per cent., notwithstanding that nearly a million cubic feet less gas had been used in the public lamps, owing to the introduction of electricity. Past experience enabled him to say that the increase would be about 20 per cent. per annum in future; but this year it would only be about 12 per cent. The works of the Company had been well managed, and were in excellent order; most of the apparatus and plant, especially the more important sections, being very largely—over 100 per cent.—in excess of present requirements. To meet the increase in consumption, there would have to be some expenditure on mains, meters, and service-pipes; but very little on the works, until the consumption had doubled. The Morecambe Authority were acting wisely in seeking to acquire the works. The dismemberment clause (No. 18) was a fair and proper clause as between all the parties. It was usual, in the purchase of a gas undertaking by a local authority, for the transfer to be effected on the basis of profits—really goodwill; and this was the way in which Morecambe would proceed. The "old-iron" clause sought by the Heysham Council, would be obviously unfair; for the result would be that the Morecambe Council, having bought not only the pipes and apparatus in Heysham, but also the goodwill, would have to sell merely the pipes and apparatus, and bear the loss of the cost of the goodwill. The price agreed on was fair.

The CHAIRMAN: Could you tell us what effect, generally, electric light has had on the consumption of gas?

Witness: Almost universally it has given an impetus to the consumption of gas. I do not know of more than two places where it has had an adverse effect on gas consumption; and one of those places is here in London. The Gaslight and Coke Company have suffered by reason of the public theatres and hotels having resorted to the electric light; but with this exception, almost throughout the kingdom electric lighting has given an impetus to the consumption of gas. In Manchester, it has been very large. There is no place in England where electric lighting has been so successful as in Manchester. This year they are spending £100,000 on the extension of electric lighting, but £250,000 on gas lighting.

Further examined by Mr. LLOYD: In 1898-99, the falling off of gas supplied for public lighting by the Morecambe Company was about a million cubic feet, which was in consequence of electricity being applied for this purpose; but the net gain in the year was 29·18 per cent. It was to be remembered, however, that the price at that time was 3s. 8d. per 1000 cubic feet, whereas now it was 3s. 3d.

Cross-examined by Mr. BLENNERHASSETT: The price of gas would have to be raised; and this would tend to reduce the consumption in ordinary places, but not in a seaside town like Morecambe. Perhaps as a result there would not be the same rapid growth in Morecambe. The doubling of the consumption in 3½ years actually took place when the price was 5d. per 1000 cubic feet more than it was now. If the rise in price reduced the consumption, the value of the concern would not be lessened proportionately. The rise might have some effect; but it would never, he believed, reduce the profits. In 1893, 1894, and 1895, there were reductions in the gas consumption of 29,000, 29,000, and 25,000 cubic feet respectively. He was not aware that this was in consequence of extensive alterations. Then an increase took place; but he should not expect such a result, as following the decrease, because the population had doubled since 1891. He, however, admitted that, if the natural increase was checked for three years, an abnormal increase might be expected in the succeeding years. There had been a boom in Morecambe for the last three or four years; but he was not aware it had ended. After the purchase, the annual liability would be £7451. Witness was then cross-examined in detail regarding the items of the estimate he had made of the way this charge was to be met. He denied that, as a consequence of coal rising 5s. a ton, there would be a large deficiency. It would not be so, because the Corporation would raise the price of gas. For every 10d. per ton increase in the cost of coal, it would be necessary to raise the price of gas 1d. per 1000 cubic feet.

Wednesday, June 20.

Mr. *Newbigging*, further cross-examined by Mr. BLENNERHASSETT, said it was not his experience that wherever there was a considerable increase in the consumption of electricity the consumption of gas was most materially checked. Witness was questioned at considerable length to show that his estimate of the income from the gas concern would not be sufficient in the future to meet the charges upon it, unless the price of gas was raised; but he maintained that the income would be enough. In the House of Commons, witness assumed an increase of 20 per cent. in the sale of gas; but he now reduced this to 12 per cent. This, however, would not interfere materially with his calculations as to the profits being sufficient to meet the charges.

Re-examined by Mr. LLOYD: The price agreed upon was reasonable. If the cost of coal increased, the price of gas could be raised also; and so the profit would be the same, though there might be a tendency to take less gas if the price were raised. The transfer would result (as these purchases usually resulted) in a deficit for the first year or two, and then in substantial gain for the Local Authority, and also for the gas consumers.

Mr. *Corbet Woodall*, examined by Mr. BALFOUR BROWNE, said electric lighting was much in vogue now; but he had no experience that its advance had been of injury to gas undertakings either at home or abroad, except in the case of London, where, north of the Thames, the rate of increase had been checked. He should not expect the installation of electric lighting in Morecambe to check the consumption of gas; and he saw no circumstance to suggest that the present rate of increase would not be continued, though there might be ups and downs. The bargain made between the Company and the Morecambe Authority was perfectly fair to both sides; being based on the profits earned and the rate of increase. If the parties had gone to arbitration, he thought the Company would almost certainly have been awarded at least the sum agreed on. The gas consumers would derive benefit from the purchase, because the Local Authority would be able to raise the money which would have to be spent on the works at a cheaper rate than the Company. He had no doubt Mr. Newbigging's estimate of the profits would be more than realized. The capacity of the works could be doubled at a cost of £300 per million cubic feet, whereas the usual figure for the construction of works was about £600 per million cubic feet. As regarded the petition of Heysham, he said the purchase was made on a commercial basis; and it would not be fair that Morecambe should be required to part with any portion of the undertaking except on this basis. It would be monstrously unfair that Heysham should be able to buy its portion of the concern at old-iron price.

Cross-examined by Mr. BLENNERHASSETT, who suggested that if the enormous loss arising from the increase in the cost of coal, which would practically sweep away half the profits of the Company, were met by an increase in the price of gas, there would be, under the sliding-scale, a reduction of divisible profits, which formed the basis of the valuation, and thus the agreed price would be affected, witness said if the Company were continuing, the increase in the price of gas would necessitate a reduction in the amount of divisible profit; but the Company were not continuing. The Local Authority, after the transfer, would enter upon a given amount of profit; and if, owing to circumstances, there was a further increase in the price of coal, the Authority would make an equal increase in the price of gas. Thus they would remain exactly where they were when the transfer was effected. If the Company were continuing, he should not advise them to raise the price, because they could go through the present year without doing so. There was a distinct difference between the Company and the Local Authority. The latter would have to raise the price, because they had not the reserves which the Company had accumulated.

Mr. *E. H. Stevenson* gave evidence in support of the Bill; agreeing as to the excellent condition of the works, as to the possibility of doubling their capacity at a very small expenditure, and as to the price agreed on being exceedingly fair.

In cross-examination, witness said that, if Heysham wished to separate from Morecambe, they would have to pay for the goodwill; but no arbitrator would have regard, in such an arbitration, to the price paid by Morecambe to the Company, although that price would be one which had the sanction of Parliament. It would be absolutely wrong to let Heysham leave Morecambe by paying the bare value of the works and pipes in their district. The model clause had no bearing on a case like the present. It had only been once put by a Committee into a Bill in which it had not previously existed; and that was a unique instance, where power was given to a local authority to purchase the gas undertaking at structural valuation. Between 1890 and 1899, there were thirty cases of the model clause, and seven of the undertaking clause. But in the thirty cases, the large majority had no works outside their district. This clause was often put in where there was practically nothing outside to sell. Which clause ought to be inserted, entirely depended on the circumstances of each particular case. Where an undertaking was bought on commercial principles, and where gas was sold outside to the extent of one-third, the commercial principle ought to be acted on with regard to the outside authority.

Re-examined by Mr. LLOYD: At the present moment, Heysham could only undertake their own supply by purchase of the Company's works at commercial value.

This closed the case for the promoters; and evidence was then called for the Heysham Authority.

Mr. *A. Silverthorne*, examined by Mr. BLENNERHASSETT, said if any adverse conditions arose in the manufacture of gas, Morecambe would almost certainly prefer to raise the price rather than make good any deficiency by a rate-in-aid; because in the former case the burden would fall on Heysham, whereas in the latter it would fall on Morecambe only—Morecambe having no power to levy a rate on Heysham. The obvious interest of Heysham was to contract themselves out of the area, under the operation of the model clause. The Bill contained an attempt to make Heysham pay for goodwill; and he therefore advised them to oppose it, because this certainly was not a case in which an outside authority should pay for goodwill. It was an attempt to re-open the model clause as settled by the House of Lords. Between 1890 and 1899, there were thirty Gas Bills and twenty-two Water Bills in which the model clause had been introduced. The undertaking clause appeared in four gas transfers within the same period. The price agreed on he considered excessive. The real test to apply was that of the relation of profit per ton of coal. It was alleged here that the profit made had been 15s. 6d. per ton, which at once showed that the thing was utterly wrong, because the figure for the whole of Lancashire was no more than 10s. 6d. This was an indication that the basis of valuation was inflated. The purchase involved an annual liability of £7255, to meet which all the income they would have would be £3700; and even from this must be deducted the interest on the loan—leaving only £3348, which, at 25 years' purchase, brought out the approximate value at £83,700, against the £141,000 agreed upon. Witness also referred to the phenomenal increase which had taken place in the use of electricity, which must largely affect the increase in the consumption of gas. The price was out of all proportion to the value of the undertaking; and Heysham would have to pay part of the excessive price if they purchased their portion of the concern.

Cross-examined by Mr. LLOYD: The great point between Heysham and Morecambe was as to whether it was fair that Heysham should pay for goodwill if they bought their portion of the undertaking. He admitted that witnesses called in the House of Commons from Heysham had agreed as to the fairness of paying for the goodwill; but they did not understand the question.

Re-examined: If Heysham were driven into this purchase by the action of Morecambe, it would be a gross injustice to make them pay a proportion of the extravagant price agreed on between the Company and Morecambe.

Mr. *Fletcher W. Stevenson*, while agreeing that the works were in good condition and in excess of requirements, except as regarded boilers, coal-stores, and station-meter, said the price was not only excessive, but the highest he knew of. The works could not be made to pay at such a price. In 1901, he thought there would be a deficit of £3471, which would necessitate a rise of 10d. per 1000 cubic feet in the price of gas. Cross-examined, witness said if the model clause would result in considerable

loss to Morecambe, he would not have advised its insertion; but if the loss would only be small, there would be no harm in inserting it. He considered the consumers in Heysham were better off under the Company than they would be under the Morecambe Authority.

Local witnesses having been called,

Mr. BLENNERHASSETT addressed the Committee on behalf of Heysham. He submitted that absolutely no case had been made out for the Bill; that there was no evidence of desire to purchase on fair terms; that it had been conclusively shown that the price was extravagant; and that it would be a great injury to the people in the whole district of the Company. The question of price was never before the people of Morecambe; and therefore it could not be said that they were supporters of the Bill. If the Committee did not reject the Bill, he asked them to give a means of escape by inserting on their behalf the model clause, for which there were many precedents in cases of both gas and water transfers.

Mr. BALFOUR BROWNE briefly replied.

The Committee then deliberated in private. On the re-admission of the public,

The CHAIRMAN said: The Committee have decided to proceed with the Bill, without the modification asked for in clause 18.

Mr. BLENNERHASSETT applied for the insertion of a clause, similar to that put in the Glastonbury Bill, providing that the instalments of the sinking fund should be divided and carried to the credit of the two Authorities in the proportion of the revenue arising from the gas consumed in the respective districts.

The CHAIRMAN said the Committee could not entertain the proposal.

Mr. BLENNERHASSETT pointed out that, as the Morecambe Bill now stood, if at any future time there should be a profit on the gas undertaking the whole would go in reduction of the Morecambe rates. This obviously was not fair, as the profit would be derived in part from Heysham. He therefore asked for provision that the profit, if any, should be applied to reduce the price of gas.

Mr. BALFOUR BROWNE objected; pointing out that, while his learned friend wished to share any profit, he did not propose to share any loss.

The CHAIRMAN declined to accede to the application.

The clauses were then adjusted; and the Bill was ordered to be reported to the House.

THE PARLIAMENTARY COMMITTEE ON MUNICIPAL TRADING.

The Joint Committee of the Houses of Lords and Commons, appointed to consider and report as to the principles which should govern the powers given by Bills and Provisional Orders to Municipal and other Local Authorities for industrial enterprise within or beyond the area of their jurisdiction, resumed their sittings after the Whitsuntide recess on the 15th inst., under the presidency of the Earl of Crewe.

The first witness called was Mr. Chandos Leigh, Q.C., the Speaker's Counsel, who gave evidence as to the practice in regard to Private Bills, their examination, and the means taken to prevent the introduction of clauses which might be objectionable in the public interest. He instanced certain Bills and groups of Bills, promoted by municipal corporations during the present and preceding sessions, which had called for special supervision. They related, in the main, to electric lighting and tramways. In one Bill, promoted by the Rochdale Corporation, there was a clause to enable the Corporation (who were the owners of the market) to create ice stalls, and further to set up refrigerators and to make and sell ice. This was a clear case of municipal trading. A Bill promoted by the Walsall Corporation contained a similar clause. It was at present before the Committee. Such powers were entirely novel, and would not be allowed without careful inquiry. The most important of the novel clauses met with in Municipal Bills was that which related to the raising of money by bills and promissory notes. This was tantamount to issuing new stock; and, where a city or town had sufficient status in population or finance, it might safely be allowed. Asked as to the practice of the Committee on Police and Sanitary Regulations Bills in dealing with novel clauses, witness said that all Bills, and in particular the unopposed ones, were carefully scrutinized. Bury promoted a Bill some years ago which contained a clause making any person who played games on Sunday liable to a penalty of £5. He took upon himself to strike it out. The Chairman asked if *locus standi* was given to any private trader against a Corporation Bill seeking trading powers. Witness said it was not. In the Rochdale ice cream case, it was decided that a private trader could not oppose. The question was, if one trader were allowed *locus standi*, where they were to stop. In an application for municipal slaughter-houses, every butcher in the town might object. The conclusion come to was that this was a question of general policy, and that, as matters stood, *locus standi* could not be given. The Committee would no doubt express its opinion on the point. With regard to Gas and Water Bills, witness said he thought no private company could have carried out a water scheme like that of Manchester, Birmingham, or Liverpool, or the very vast scheme of last session for dealing with the water of the Derwent Valley. At the same time, he rather deprecated the practice of acquiring compulsorily a water or gas undertaking by a municipality against their will and without their consent. This practice had increased to an enormous extent during the last few years. There were in Great Britain 250 local authorities who held gas undertakings, and practically in all these cases the businesses had been originally founded by a company and subsequently purchased by the municipality. One might say, broadly, that the municipalities never invented or initiated anything with reference to tramways, gas, or electricity; and yet when a company had become flourishing, they had been forced into a corner. He did not know of any case in which a municipality had bought a gas undertaking which was not in a flourishing condition. With regard to restrictions upon municipalities in the matter of competition with private traders, witness did not give any opinion of his own, but cited the views of a prominent gas official, who stated that the manufacture of apparatus and fittings would in most cases be carried on equally well, and at less cost, by a manufacturer apart from a company. Therefore the gentleman referred to would be content to see a restriction placed equally on a company and a corporation. Asked what restrictions Parliament had ever put on local authorities with respect to subscribing to various enterprises, witness said they were never allowed to subscribe to an undertaking over which they had not absolute control; but this rule had been infringed on two or three occasions lately. The first case was that of the Hull and Barnsley Railway, in which the Corporation of Hull were allowed to subscribe £100,000 towards the undertaking. The next case was the well-known one of the Manchester Ship Canal. In 1891, the Canal Company asked Parliament to allow the Corporation to subscribe £5,000,000 towards the undertaking. This was an enormous sum for a corporation to contribute, and he remembered perfectly well going to the House of Lords and saying that they had a strong feeling about it in the House of Commons, and that they had always discountenanced such a proposal. In fact, when the Manchester Ship Canal was first started, Salford wished to contribute £250,000; and Parliament disallowed it. But in the end the Corporation of Manchester were allowed to subscribe the money. This was municipal trading of a very municipal kind. Witness put in a statement showing the increase in rates and local debt in proportion to population throughout the United Kingdom from 1878 to 1897. The increase of population was 21 per cent.; that of rates 25 per cent.; and that of local debt, 120 per cent. He had said that he did not know of a case in which a corporation had acquired a gas undertaking which was not in a flourishing condition, and possibly the inference would be that a corporation did not want to take over a concern that was not so. Sir W. Foster asked if it was not explicable on this ground, that where there was a flourishing gas company there was an increasing community and a prosperous town, and therefore a more progressive town council. Witness said this was a question he did not wish to go into.

The next witness was Mr. Sidney Morse, Chairman of the Municipal Trading Committee of the London Chamber of Commerce, who spoke upon the general question of municipal trading. He said he thought that, apart from any abstract objections to such trading, the hands of municipalities were already too full, and they could not spare the time for it. He had frequently had his attention called to the enormous amount of work they had to do; and they suggested that it would be serious if their attention were turned therefrom to matters out of which profit might be made. With regard to tramways, he had found that local authorities did not always appear to consider the question whether or not the proposed lines were desired in the public interest. He had pretty much the same complaint to make with regard to electric lighting. As to the working of tramways, he did not wish to say it was impossible for a municipality to do this fairly well; but, as a rule, those who obtained the management of a tramway by being on a municipal body had to a very small extent experience of the matter, and it was impossible for people without experience to manage a complicated business, and, even with a staff of competent persons, to continue its proper management.

Last Tuesday, Mr. Morse, continuing his evidence, put before the Committee the principle that the action of municipalities in trading should be restricted to matters undertaken in the public interest, and not with a view to making profit—matters in respect of which reasonable rates might be made. The supply of water was to a large extent so much in the interest of everyone, that it should be furnished in proper, wholesome, and pure condition; and it was reasonable that a rate should be made to give that supply pure. One of the difficulties connected with water, however, was that an authority had sometimes to go outside their district for a supply. If they only allowed trading, it was extremely difficult to say, as a matter of principle, that they should draw the line at a particular geographical limit. If they permitted a local authority to carry on a trade and to make no more profit than was sufficient to repay capital and pay expenses, it was very difficult to set a limit to what they might not do. He wished to call attention to the great importance of supervision in such matters as tramways; and as an indication of the vastness of municipal undertakings, he mentioned that the city of Glasgow now employed 20,000 workpeople. If municipal trading were allowed, it must result in abolishing the private trader, and the effect of such abolition upon the wealth of the country would be very serious indeed. Asked by the Chairman what distinction he drew between water and gas, witness said it was essential, from a sanitary point of view, that every house should have a good supply of water, not only for the individual householder, but also for his neighbours. It made no difference to a householder whether his neighbour had any light or used gas, candles, or lamps. If the neighbour preferred lamps, why should he contribute his capital for the benefit of the man who had gas or electric light? The exception he made in the case of water was based on sanitary grounds. The refusal by corporations to consent to companies introducing electric light and tramways had undoubtedly retarded progress in these branches of industry throughout the country.

Mr. S. B. Provis, Permanent Secretary of the Local Government Board, next gave evidence. In the course thereof he stated that the total indebtedness of local authorities in England and Wales had increased about 51 per cent. between 1885 and 1898; the figure in the former year being £173,207,000, and in the latter year £262,017,000. The Board had no jurisdiction over Scottish and Irish matters. He regarded the supply of water by these authorities as a question which stood in a different position from others with which the Committee had been dealing. The restriction that should be placed upon outside trading in water was that the supply should be made to the authority in bulk, and not to the consumers directly. This had been a more common practice of late years.

Discontinuance of Oil Lighting at Stoke-sub-Handon.—The Council of this parish have decided on employing gas in place of oil for the public lighting; and the tender of the Martock Gas Company has been accepted for its supply.

The Leamington Corporation and the Gas-Works.—In the last number of the "JOURNAL" we announced the refusal by the Leamington Priors Gas Company of the offer made by the Corporation to purchase their undertaking for £140,000. The local papers are speculating as to what will be the result. If the matter goes to arbitration, it is thought that the Company will not get as much as they ask, but that they will, at all events, be awarded £20,000 more than the Corporation offer. The question is asked: Do the Leamington ratepayers wish to buy the works at this figure? It is said there is every reason to believe that a mutual arrangement might be come to by which the purchase scheme could be dropped.

LEGAL INTELLIGENCE.

COURT OF APPEAL (IRELAND).

Wednesday, June 20.

(*Before Lord Justice* FITZGIBBON, *Lord Justice* HOLMES, *and Lord Justice* WALKER.)

Alliance and Dublin Consumers' Gas Company v. County Council of Dublin —Damage to Gas-Pipes by Steam-Rollers.

This was an appeal by the Dublin County Council against a judgment of the Master of the Rolls (*ante*, p. 815) restraining the Council from using, or causing to be used, a steam-roller in such a way as to fracture, damage, or injure the gas mains, pipes, or other works of the Gas Company. It appeared that the respondents sustained injury by reason of damage to some of their pipes laid beneath the roads in certain districts of Dublin; and they alleged that the injury was done by a steam-roller used by the County Council for the purpose of repairing and keeping the roads in order.

Mr. T. L. O'SHAUGHNESSY, Q.C., Mr. T. M. HEALY, Q.C., and Mr. J. J. CLANCY appeared for the appellants; Mr. S. RONAN, Q.C., Mr. J. GORDON, Q.C., and Mr. J. PIM represented the respondents.

The arguments occupied the day.

Thursday, June 21.

To-day the arguments in the case were concluded, and

Lord Justice FITZGIBBON stated the decision of the Court, which was that the injunction should be amended so as to read in the following form: An injunction against using any steam-roller on any road under which the gas-pipes of the plaintiffs have been laid, so as to break or injure any pipes then properly laid under such road; regard being had to what, at the time of the laying of such pipes, was the then ordinary traffic and the then reasonable means of repairing and maintaining the road.

The appellants were ordered to pay the costs of the appeal.

CHANCERY COURT OF LANCASHIRE.

Manchester, Thursday, June 14.

(*Before Vice-Chancellor* HALL, Q.C.)

Taylor v. Oldham Corporation.

This was an action brought by Moses Horrocks Taylor, of Ogden, against the Oldham Corporation. The plaintiff, as Trustee under the will of James Taylor the elder, deceased, claimed an injunction to restrain the defendants from discharging or permitting to flow into the Ogden reservoir, from the Kitcliffe Mill or elsewhere, any foul matter or liquid, so as to pollute the reservoir, to the injury of the plaintiff as owner of the Ogden Mill and premises, and contrary to the provisions of the Oldham Corporation Water-Works Act of 1870 and other Local Acts of the defendants; and from diverting, interfering with, retaining, or appropriating any of the water of the Piethorn Brook until the defendants had constructed such works as were necessary to collect and restrain separately the water fouled at the Kitcliffe Mill, as provided by the Act of 1870; and also to restrain them from interfering with the supply of water by means of a 15-inch pipe from the Wicken Brook, to which the plaintiff was entitled under an agreement dated the 4th of May, 1870, and from acting in breach of that agreement. Plaintiff further claimed an order upon the defendants to forthwith remove from the 15-inch pipe a grid at the mouth thereof, and a valve connected therewith, and to cut off from such pipe a communication with a pipe of defendants, whereby they had wrongfully diverted water from the 15-inch pipe.

Mr. MABERLY appeared for the plaintiff; Mr. SUTTON and Mr. EASTWOOD represented the Corporation.

Mr. MABERLY, in opening the case, stated that for a great number of years the Corporation had, without the knowledge of the plaintiff or his predecessor in title, connected a pipe to the 15-inch pipe of the plaintiff, and had drawn water therefrom, although the plaintiff was entitled to the sole water supply. Since the action had been commenced, the defendants had severed the connection with the 15-inch pipe of the plaintiff.

Cross-examined by Mr. SUTTON, plaintiff said he had been aware for a number of years that the 15-inch pipe had not carried the normal quantity of water, and he found the outlet for the abstracted water before 1886, but made no complaint. He further stated that the Ogden reservoir was about 700 yards long, and he had noticed pollution for a distance of 50 yards, but never at the overflow.

Counsel explained that the reservoir was not for domestic purposes, but for compensation.

Friday, June 15.

The case for the plaintiff was concluded this morning, and evidence was submitted on behalf of the defendants.

Mr. *G. H. Hill*, who designed the works, was called to show that the "secret-service" pipe was not a secret one at all. He admitted that the bars across the mouth of the 15-inch pipe would probably cause obstruction to the flow of water to which the plaintiff was entitled.

Vice-Chancellor HALL, in giving his decision, said he was of opinion that there would be silting up, and he recommended the Corporation—though he did not find that they were to do it—to adopt some different plan which would obviate this. He was of opinion that there had been pollution, and that there should be an inquiry in regard to damages. As to the other point, it was not the case, as the plaintiff had said, that there had been stealing of water by a secret pipe. It was ludicrous to make a statement of this kind in face of the facts. He was of opinion, as he had said, that there had been pollution, and he would grant an inquiry as to the damage. He would also make a declaration, in the language of the Act, that the Corporation must not permit any foul water to flow from the Wicken Brook into the Ogden reservoir, and he would give liberty to apply in the future for an injunction. He again suggested to the Corporation that they should make such arrangements as would prevent silting up, and the free flow of water from the 15-inch pipe which the plaintiff was entitled to. Regarding costs, he thought that, as to the pollution, the plaintiff was right when the action was commenced, and he considered that the costs of the action ought to be paid by the defendants to the plaintiff, except those referring to the part of the case about the interception and diversion.

Monazite Sand for the Manufacture of Incandescent Mantles.

In the Queen's Bench Division of the High Court of Justice on Friday, Mr. Justice Bruce and a Special Jury had before them an action brought by Mr. George Oppenheimer against the Anglo-Continental Gold Mines Company, Limited, to recover damages for breach of contract in not having employed him to sell a large quantity of monazite sand, used in the manufacture of incandescent mantles. The Company denied the alleged contract. Sir Edward Clarke, Q.C., and Mr. Whateley appeared for the plaintiff; Mr. Lawson Walton, Q.C., and Mr. A. M. Bremner represented the Company. The plaintiff's case was that on May 28, 1897, he was engaged by the Company to go to Germany to endeavour to sell some 2000 tons of monazite sand, which the Company said contained about 12 per cent. of thorium and 9 per cent. of cerium. Plaintiff was to get all the information he could about the market, and communicate with the defendants. He was to be paid his travelling expenses and 7½ per cent. commission on sales. On this understanding he went to Germany, and on one occasion he wrote to the Company saying that he could dispose of about 1000 tons; but they requested him to return. As a matter of fact, plaintiff said, the Company never had the material in their possession. He had been paid his travelling expenses, and he now claimed his commission on what he said he could have sold. For the Company it was stated that, on the strength of information they received as to a parcel of 2000 tons being available for purchase in Brazil, they engaged the plaintiff to dispose of it, as they knew he was connected with the incandescent mantle business. The plaintiff went to Germany to report on the state of the market, so that they might know whether or not to accept the offer of the sand, and whether it would be a profitable transaction. The transaction, however, was never completed, and the Company had lost over the business. After evidence had been called, a consultation took place between Counsel, and in the result judgment was entered for the plaintiff for £500.

Liability for Water-Rate.

At the Westminster County Court on Monday last week, a claim by the Grand Junction Water Company against Messrs. Eastman and Son for £4 4s., arrears of water-rate, came before his Honour Judge Lumley Smith, Q.C. Mr. K. B. D. Acland appeared for the plaintiffs; and Mr. W. de Bracy Herbert, for the defendants. Mr. Acland said Messrs. Eastman and Son occupied the lower portion of No. 3, Clifton Road, Maida Vale, under a three years' agreement from Midsummer, 1896. The rate was then paid by Mrs. Boulton, the lessor. She had since died, and Mr. Bentwich became the lessor. He paid one rate and refused to pay any more. The defendants would not pay, claiming that they were not liable because there was a covenant in their lease (they being now lessees of the premises) under which the lessor was to pay all rates and taxes. The Company called upon the occupier, who was statutorily liable when the owner would not pay. A clerk from the office of the Paddington Vestry produced the rate-book, showing that the defendants were the occupiers of the premises in question, which were rated at £50 per annum. The Company's collector deposed that the amount claimed was due. Mr. Herbert said practically all the facts were admitted. He asked his Honour to find that there was, in point of fact, an agreement between the owner and the Company that the rate should be paid by the owner. The Company took the rate from the owner for ten years, and gave receipts in the owner's name. His Honour remarked that the Company got their money and gave a receipt, not an agreement. Mr. Herbert submitted that there was a tacit agreement. His Honour said he did not infer that there was, and thought the plaintiffs were right. He gave judgment for the Company, with ordinary costs, and certified for Counsel.

A Workman's Claim Against the Birmingham Corporation for Injuries Received.

At the Rhayader County Court, on Thursday, an interesting case came before his Honour Judge Evans. The plaintiff was James Edward Baxter, who claimed £50 from his employers, the Birmingham Corporation, for injuries received while working on their quarry in connection with the Birmingham Water-Works at Elan Valley, through the alleged negligence of the defendants. Evidence having been given as to the cause and the nature of the injuries, Mr. Careless, for the defendants, said the plaintiff had elected to make his claim under common law apart from any claim he might possibly have under the Employers' Liability Act or the Workmen's Compensation Act; and therefore the defendants set up the plea of common employment, contending that they were only liable for personal negligence and not for the negligence of any of their servants, even if there had been any negligence, which was not admitted. His Honour said the case was a novel one. The defence was fatal to the common law claim; and though there might have been negligence on the part of the Corporation's servants, he must nonsuit plaintiff.

Robbing a Prepayment Meter at Rotherham.

Herbert W. Brierley was charged at the Rotherham Police Court, on Thursday, with stealing 2s. 7d. from a prepayment meter, the property of the Corporation. The Town Clerk (Mr. H. Hampton Copnall) prosecuted on behalf of the Gas Department. He stated that an inspector, on going to take the state of the meter, found the lock had been forced. There should have been 3s. 4d. in the box; but there was only a penny. Defendant admitted he broke the lock open while he was drunk, and took out 2s. 7d. William Pratt, an inspector, stated that the defendant had admitted to him that he had taken the money, saying he was very sorry, and would not do it again. A police sergeant said, when he served the summons on defendant, the latter remarked that he would not have taken the money if he had not been under the influence of drink. Defendant was fined 5s. and costs.

MISCELLANEOUS NEWS.

THIS YEAR'S EXAMINATIONS IN GAS MANUFACTURE.

The Pass List.

The following are the names of the successful candidates at the last examinations in "Gas Manufacture" conducted by the City and Guilds of London Institute. The question papers set by the Examiner (Dr. Harold G. Colman) were given in the "JOURNAL" for May 8, p. 1238:—

HONOURS GRADE.

First Class.

Cranfield, W.	Halliwell, S. E.	Johns, W. H.	Pearson, D. U. R.
Edwards, A.	Hoggard, A. W.	Nelson, R.	Winslow, D. J.

Second Class.

Astbury, E.	Dougall, A.	Mottram, A. E.	Snowball, W. N.
Brettle, J.	Hislop, L. R.	Oldfield, F.	Studholme, J. H.
Browne, B. F.	Holton, A. L.	Port, H. N.	Townsend, W. W.
Buckley, H.	Judd, G. H.	Robson, O. H.	Williams, H. R. S.
Campbell, J. M.	Knight, H. S.	Scarth, P. F.	
Caton, W. E.	Longbottom, W.	Smith, H.	
Cule, T. G.	Mead, A.	Smith, S. T.	

ORDINARY GRADE.

First Class.

Barnes, F. V.	Dickson, J.	Holland, J.	Thorman, J. S.
Barrett, F.	Garlick, D. E.	Taylor, J.	

Second Class.

Amos, F. H.	Brentnall, J. A.	Hitchens, A. W.	Norman, R.
Anderson, G. W.	Brooke, J. B.	Hutchinson, E.	Ramsden, R. S.
Armstrong, J.	Chandler, D.	Ireland, C. L.	Rice, J.
Barber, L. G.	Cowper-Smith, M.G.	Jowett, T.	Stewart, R.
Bird, F. E.	Gaunt, J.	Legge, H.	Wellens, E. J.
Bowden, R.	Haudley, H. C.	Mead, H. S.	Whyte, J. N.

THE GAS AND WATER ORDERS OF THE PRESENT SESSION.

The Board of Trade have published a memorandum stating the nature of the proposals contained in the Provisional Orders included in the Gas Orders Confirmation (No. 1) Bill. The Orders relate to Abergele, Irthlingborough, Littlehampton, Lymington, Mablethorpe and Sutton, and Romford. The Abergele Order is to empower the Abergele Gas, Coke, and Water Company, Limited, to maintain and continue gas-works, and to manufacture and supply gas within the urban district of Abergele and Pensarn and the rural district of Abergele, in Denbighshire. The Irthlingborough Order is to authorize the Irthlingborough Gas and Coke Company, Limited, to construct, maintain, and continue gas-works, and to manufacture and supply gas in the parishes of Irthlingborough, Little Adlington, Great Adlington, Woodford, and a portion of the parish of Chelverton-cum-Caldecott, all in Northampton. The Littlehampton Order is to enable the Littlehampton Gas Company, Limited, to construct further works for storage purposes, extend their limits of supply, raise additional capital, &c. The Lymington Order is to give the Lymington Gas and Coke Company authority to maintain and continue gas-works, and to manufacture and supply gas within the borough of Lymington, and the parishes or portions of the parishes of Milton and Boldre, all in the county of Southampton. By the Mablethorpe and Sutton Order, the Mablethorpe and Sutton Gas Company, Limited, will be able to maintain and continue gas-works, and manufacture and supply gas in the parishes of Mablethorpe, Trusthorpe, and Sutton-le-Marsh, in Lincolnshire. The Romford Order is to empower the Romford Gas and Coke Company, Limited, to raise additional capital, and for other purposes.

Another memorandum issued by the Board deals with the proposals contained in the Orders included in the Gas and Water Orders Confirmation Bill. They are four in number. The first is to empower the Hoylake and West Kirby Gas and Water Company, Limited, to purchase certain lands by agreement, construct additional gas and water works, and raise further capital for this purpose, and for their gas and water undertakings generally. The next is to authorize the Manningtree and Mistley Gas Company, Limited, to maintain and continue gas-works, and manufacture and supply gas within the parishes of Manningtree, Mistley, and Lawford, in Essex. The South Elmsall, South Kirkby, and North Elmsall Gas Order will give Mr. Charles Scholefield power to construct, maintain, and continue gas-works, and manufacture and supply gas in the townships or parishes of South Elmsall, South Kirkby, and North Elmsall, in the county of York. The last Order in the group is to enable the Steyning and District Water-Works Company, Limited, to raise additional capital for the purposes of their undertaking.

THE INCREASED PRICE OF GAS IN THE METROPOLIS.

The notice given by the Gaslight and Coke Company of their intention to increase their price by 6d. per 1000 cubic feet, as mentioned last week (p. 1663), has given rise to various comments in the Press.

The "Financial News" had a leading article on the subject last Friday in the course of which the following remarks were made: "So far as the three leading Metropolitan undertakings are concerned, the South Metropolitan charge is to be raised 3d. per 1000 cubic feet, from 2s. 1d. to 2s. 4d.; while the Gaslight and Coke and Commercial Companies have decided upon double this rate of augmentation—the former from 2s. 11d. to 3s. 5d., and the latter from 2s. 6d. to 3s. The advance is understood to be due to the increase in the price of coal. But, so far as we are aware, none of the Companies have deemed it necessary or courteous to offer any sort of explanation or justification for the step so generally agreed upon. The Gaslight and Coke Company certainly has not; but that practically goes without saying; for this Company is very seldom to the fore in endeavouring to conciliate its customers or to popularize its service. Yet it will scarcely be denied that a sudden advance of 17 per cent. is a very serious matter for the Company's consumers whose business premises or private residences happen to be situate on the north of the Thames; for, as our readers are aware, its more fortunate customers 'over the water' have the price of their gas regulated by the more moderate scale of the South Metropolitan Company, and will even now have to pay only 2s. 4d. per 1000 cubic feet. Perhaps the absence of any explanation of the rise is discreet; for to have given it with any show of reason would have necessitated some statement of the basis upon which the new coal contracts have been entered into, on the one hand, and, on the other hand, to have enabled consumers to form some idea of the extent to which the enhanced cost of fuel is being counterbalanced by the improved prices of residuals. As matters stand, we are left in the dark with regard to both points—at all events, so far as the current half year is concerned. In the past year, however, the increased cost of the coal used by the Gaslight and Coke Company—which in this respect may be taken as typical of the whole group of gas undertakings—was more than offset by the larger receipts from the sale of residual products." Having critically examined the Company's accounts for the past year, the writer proceeded: "An advance of 6d. per 1000 cubic feet in the Company's charge for gas is a very tall order; and we are not at all surprised to hear that a large number of gas-stoves have been returned to the Company as a protest against the extra charge upon which Colonel Makins and his colleagues have decided. Under the sliding-scale arrangement, the dividend upon the ordinary stock of the Company will have to be reduced rateably with the increase in the price of gas charged to consumers north of the Thames. . . . It is obvious that the increase in the price of gas is a serious business for the shareholders of the Companies, and particularly for those of the Gaslight and Coke Company, as well as for the general consuming public. The Company can ill afford to add to the unpopularity it has done so much to foster; and we cannot but think that the Directors would have been well advised to strain every nerve to make the augmentation in its charge for gas as small as the circumstances would allow. The Directors are fond of posing as the victims of popular prejudice and the unjustly criticized of Mr. Livesey and other gas experts; and they will now be able to add the members of the Select Committee of the House of Commons to those who have persistently misunderstood their capacity and their good intentions. . . . The Gaslight and Coke proprietors would do well to read the evidence furnished regarding their affairs to that Committee, and endeavour to find out from it whether those who are entrusted with the control of their interests are pursuing a sound or businesslike policy in annoying and flouting their customers at every turn."

The "Financial Times" for Thursday had an article on the subject, in the course of which the writer gave the views of Mr. George Livesey thereon, as expressed to a representative on the preceding day. He attributed the rise solely to the higher price of coal: "During the last two years, he explained, gas coal had risen 10s. per ton f.o.b. on the Tyne, and this was equivalent to the addition of 1s. per 1000 feet to the price of gas; so that the extra charge imposed by the Companies did not by any means cover the enhanced expense they had been and would be put to. The war had had little to do with this development of gas coal values, though it had no doubt sent up the cost of steam and kindred coal. The great boom in the iron trade was chiefly answerable for it; gas coal being almost the only mineral fuel used in that industry. Mr. Livesey did not think the high rates ruling would prevail very long; and probably next year consumers would see the price of gas down again. It had to be borne in mind, however, that up till now the public had had the benefit of the comparatively favourable terms on which the coal contracts fixed last year were based, and which only expired at Midsummer; and, therefore, for the next twelve months, consumers must expect to have against them the present contracts, founded on practically top prices. Mr. Livesey added that the South Metropolitan Company would be pretty sure to have to still further advance the price of gas before these troublous times were over; but some consolation may be derived from his admission that not all the Company's coal contracts this year had a twelvemonth's run. There is apparently something to be said for the Companies after all, though many of the methods of their policy are hard to understand. The preferential treatment of the south over the north by the Gaslight Company is an admitted scandal, and led the Select Committee to recommend that the Company should be deprived of that portion of its area. The Committee also recorded as a fact that, as compared with its Metropolitan contemporaries and with some of the small Suburban undertakings, the price charged by the Gaslight Company was very high. The recent practices of the Company fully confirm this. If coal values were going up so much last year, why was any reduction in price made at all, if it was to be followed by an altogether disproportionate rise? It is hardly likely either that the Companies have yet exhausted the supplies of coal received under the old contracts. The Gaslight Company, at the end of 1899, had more in store than it had at the end of June; and though the stock of the South Metropolitan Company was rather low, the Commercial had three months' consumption in hand. These reflections do not offer much satisfaction to the consumer who has to pay so high a price for his light; but they will serve once more to demonstrate the need of some action being taken on the report of the Select Committee—action that has already been too long delayed."

The "Daily News" says the announcement of the increase will come as "an unpleasant shock to consumers north of the Thames. For years there have been just and general complaints of the high price of the gas of this Company, which supplies by far the largest and most densely populated area in the world, and ought to be able to effect economies in production and distribution elsewhere quite impracticable. When, in June, 1898, the Company increased the price from 2s. 10d. to 3s. per 1000 cubic feet, against a charge of 2s. 2d. south of the Thames—an excess of over 38 per cent.—popular indignation reached a climax. The London County Council and the Corporation of the City both gave voice to the general dissatisfaction; and it was proposed to oppose the Company's next Bill in Parliament, with a view to securing a reduction. Last year, in spite of the strenuous resistance of the London County Council, the Company secured the passing of an Act, the chief purpose of which was to convert each £100 of its 12 per cent. stock into £300 of 4 per cent.—thus adding at a stroke some £14,000,000 of 'fictitious capital' to the amount upon which its shareholders draw interest. Having secured this

change, and decreased prices by a penny at the end of last year as a sop to the opposing consumers, the Company now shows its teeth, and by a single stroke of the pen adds 6d. a thousand to a price which was already exorbitant."

The "Builder" for last Saturday contained the following remarks: "The Gaslight and Coke Company, London, is about to raise the price of gas to private consumers from 2s. 11d. to 3s. 5d. per 1000 cubic feet. Several weeks ago we pointed out that the high price of gas coal would probably necessitate a general rise in the price of gas throughout the country; and since then news has been coming to hand every week of the price being largely increased in one town or another. In some localities, agitations are being started to protest against the increased charges; but it is foolish to imagine that gas manufacturers who have had to pay 100 per cent. more for coal than last year can avoid raising the price of gas. We do not doubt that gas-works managers are fully alive to the fact that these increases are extremely inimical to the prosperity of the gas industry, and will in their own interests lower their charges as soon as a fall in the price of coal will permit them to do so. A section of the community appears to be of the opinion that gas manufacture ought to be carried on upon philanthropic principles at the expense of the shareholder, and does not appreciate the fact that a rise in the gas charge injures the shareholder even more than the consumer. During the last few months, the market values of many gas stocks have fallen very considerably."

We learn from the "Daily Chronicle" that the Hampstead Guardians last Thursday, on learning of the Gaslight and Coke Company's increase, were very wroth; and one of the members (Dr. Ryalls) likened the Company unto licensed highwaymen, and said that the sooner their licence was taken away the better. Another Guardian (Major Sheffield) denied that the increase was wholly due to the rise in the price of coal. He said the Company had carried out a "dodge" with their capital, so that it would appear that they were paying less dividend than was really the case. Mr. Rider thought the charge was an imposition, and should be protested against by public bodies, the Press, and business houses alike. The matter was referred to the Finance Committee.

Referring to this subject in their "London Day by Day" last Friday, the "Daily Telegraph" said: "No population in the world is so patient and long-suffering as the people of London. They suffer all sorts of inconveniences, and ungrudgingly tolerate abuses, without a murmur; but it must be said that the action of the Gaslight and Coke Company in coolly raising the price of gas 6d. per 1000 cubic feet has called forth from consumers a general chorus of indignation. The reason given is the enhanced price of coal; but on all sides may be heard expressions of opinion that the increase announced is out of all proportion to the undoubted augmentation in the cost of fuel. It should also be borne in mind that of late many companies have been adulterating the *bonâ-fide* product of coal with a considerable quantity of water gas, the price of which does not depend at all on subterranean deposits. An immense volume of gas is now used for cooking and heating purposes, and the water variety is much less useful in that direction than the other. Considerably more gas is now required to attain the same degree of heat than was the case before the system of adulteration began. The public are therefore called on to pay an enhanced price for an inferior article, on the plea that the price of coals has gone up, while at the same time they are supplied with wishy-washy stuff largely extracted from water. Yesterday an official of the Gaslight and Coke Company stated that a large number of gas-stoves had been returned as a protest against the additional 6d. He added that he would like the Directors to hear some of the unpleasant remarks to which the unoffending officials have been subject during the past day or two." Having given a list of the increases in the Metropolis and the suburbs, the writer said: "The Ramsgate Corporation Gas Committee have set an example which ought to raise a blush to the cheeks of the Directors of the Metropolitan Companies, and will certainly make residents in London long for a gas administration as energetic and as economical as exists in the popular seaside resort mentioned. The authorities there have decided, notwithstanding the increased cost of coal, not to raise the price of gas to consumers, the figure now standing at 2s. 8d. [see p. 1736]. During the financial year just closed, the Gas and Water Departments have realized profits amounting to nearly £6000, of which sum £3200 will be handed over in reduction of district rates; leaving the remainder for contingencies."

EDINBURGH AND LEITH GAS COMMISSIONERS.

The Annual Accounts.

The accounts of the Edinburgh and Leith Gas Commissioners for the year ending the 15th of May have been issued, subject to audit, by Mr. John S. Gibb, the Treasurer. They show the surplus on the year's working to be £69,458. From this surplus there has been paid: For Edinburgh and Leith annuities, £32,772; for Edinburgh-Portobello gas annuities, £1138; amount transferred to the sinking fund in respect of annuities redeemed, £1290; do. in respect of mortgages redeemed, £452; interest on mortgages, &c., £12,530; expenses of mortgages, £231—together, £48,413. After meeting these charges, there remains a balance of £21,045, which, being added to the amount brought forward from the year 1898-9, after taking away contributions to sinking funds and writing off the expense of title to the Granton land, &c., £20,654, makes the total sum at the credit of the profit and loss account £41,699. This is subject to the statutory minimum charges for the sinking funds, as follows: (1) For repayment of money borrowed, £3787; (2) for redemption of annuities, £7172—together, £10,959, which, being deducted from the above sum, leaves a balance of £30,740, which may be dealt with at the discretion of the Commissioners in terms of their Act. The Treasurer adds: "In view of the favourable financial results of the past year's operations, it seems unnecessary that the Commissioners should avail themselves of their statutory power to defer contributing, at this time, to the sinking fund in respect of money borrowed for the new works at Granton. The amount stated above, however, as the contribution to the sinking fund is calculated on the total mortgage debt alone, as on the 15th of May last. It is worthy of the consideration of the Commissioners whether, in the circumstances, the contribution to the annuities sinking fund might not be increased beyond the statutory minimum of 15s. per cent."

The capital account shows that of a total capital of £370,000, upon which there were annuities payable to the amount of £35,200, there have been redeemed annuities to the amount of £1307—extinguishing capital to the amount of £13,853. The capital now stands at £356,146, and the annuities at £33,893. Of loan capital there is authorized £800,000. There has been borrowed on mortgage £378,701; and there have been redeemed out of sinking fund mortgages to the amount of £16,320. There has been expended upon works, manufacturing plant, and gasholders £486,383, of which £44,398 was expended last year. Upon mains and service-pipes and cost of laying, the expenditure has been £269,212; last year, £26,414. There has been expended upon gas-meters, £71,002; last year, £5687. Upon gas cooking and heating stoves, £13,931 was spent; last year, £2942. The total capital expenditure now stands at £847,061, of which £79,442 was expended last year. There is a debit balance on capital expenditure account of £82,039. The total capital expenditure upon the new works at Granton, including cost of site, has been £176,681; and during last year, £44,397. There has been no capital outlay upon any of the other works belonging to the Commissioners. The total revenue for the year was £297,225, of which £256,524 was derived from the sale of 1,736,347,200 cubic feet of gas, £13,195 from the sale of coke, £26,702 from tar and ammoniacal liquor, £31 from the sale of waste lime, and the rest miscellaneous. The total expenditure was £227,767, leaving the balance of £69,458. Coal (161,383 tons) cost £103,231; oil for carburetted water gas (3523 tons), £9970; purifying materials, oil, water, &c., £9297; salaries and wages, £46,786; and repairs and maintenance of works and plant, £12,987—making the total manufacturing charges £182,272. The other charges were: Distribution of gas, £20,286; management, £8841; feu-duties, rates, and taxes, £9911; pensions and allowances, £917; law and parliamentary expenses, £251; accidental damages, £9 12s. 6d.; and discounts, abatements, and bad debts, £5277. The sinking fund for repayment of money borrowed amounts to £3958—there having been already expended out of that fund £16,320; and the sinking fund for the redemption of annuities amounts to £77,850, with £38,841 already expended out of it. The gas-stove account is kept separately from the others. During the year there was expended upon the purchase of stoves £4112; and the cost of repairing and fitting up stoves, less £500 charged to revenue account, amounted to £2165. The receipts amounted to £2085 for hire of stoves; £998 for stoves sold; and £252 for fitting up gas-fires, &c.—a total revenue of £3335. There are stoves on hand, or lent on hire, of the value of £13,931.

The accounts were submitted to the Commissioners at their monthly meeting yesterday. In accordance with the statute, they have to lie on the table for a month before they are approved of.

SOUTHPORT CORPORATION GAS SUPPLY.

The Engineer's Annual Report.

In the "JOURNAL" last week, it was mentioned that the net profit resulting from the working of the Gas Department of the Southport Corporation in the year ending March 31 last was £10,323, and that £9000 of it had been handed over in relief of the rates; leaving £1323 to be carried forward. We are now able to give further particulars in regard to the undertaking, from the annual report of the Gas Engineer and Manager (Mr. John Booth). He begins by expressing satisfaction that there was an increase in the make and sale of gas as compared with the previous year. There was, however, a falling off in the profits, owing to the enhanced prices paid for coal, oil, and other materials, though better prices were realized for residuals. The income and expenditure for gas-cookers are now brought into the revenue account, where in future they will appear. Owing to this change, a comparison with the accounts for the year 1898-9 cannot be conveniently made. The chief increases in the receipts are: Gas, £256; and residuals, £1347. The decreases are: Old iron, £261; and service-pipes and fittings, £272. The laying of service-pipes and the fixing of meters is now done free of charge. The chief items of increased expenditure are: Cannel, coal, and oil, £4143; mains and service-pipes, £689; rates and taxes, £338; general office salaries, £250; interest on loans, £227; and sinking fund, £119. The increased prices to be paid during the current year for gas-making materials will, Mr. Booth says, make a serious difference in the cost of manufacture per 1000 cubic feet; and he is of opinion that for the next twelve months at least no reduction will be seen in the selling prices of such materials. At the same time, he believes the present prices of residuals will be maintained. Under the exceptional state of things at present existing in the coal and oil markets, and the fact of their having to use a large quantity of enriching material in the manufacture of gas, he has for some time had under consideration the question of gas enrichment, and the possibility of bringing about a reduction in its cost. With this object in view, he is at present carrying out experiments on a practical scale to see if this can be effected. The sum of £3130, standing to the credit of the reserve fund, has been placed to the renewals fund. The amount standing to the credit of this fund at the end of the year was £4270, of which £500 is invested with the Corporation, and the balance is in the bank. The expenditure on capital account during the year amounted to £6265. The total outlay on capital account at the close of the year was £244,328; but a sum of £51,635 has been paid off by means of the sinking fund. There was an increase of 465 prepayment meters, and of 4,275,000 cubic feet of gas consumed by these appliances, last year; the value being £728 10s. 5d., or an average of 7s. 4d. per meter. The amount of money collected represented 271,297 pennies, equal to about 2½ tons. The number of cookers in use at the end of the year was 1834 on hire and 21 on the hire-purchase system. The number of new cookers fixed during the year was 363. In the carbonizing department, the following quantities of materials were used: Coal, 27,917 tons; cannel, 3488 tons; coke, 1319 tons; and oil, 1790 tons. The gas made was 405,128,000 cubic feet—an increase of 5,085,000 cubic feet, or 1·27 per cent., on the year 1898-9; the amount sold was 396,580,000 cubic feet, being 7,735,400 cubic feet, or 1·99 per cent., more.

Appended to Mr. Booth's report are the accounts, which are certified

by the Borough Accountant (Mr. G. Lloyd). They show a total revenue of £67,611, and an expenditure amounting to £46,939; leaving a gross profit of £20,672. The expenses of manufacture, distribution, management, &c., last year came to 2s. 3·26d. per 1000 cubic feet of gas sold. Deducting revenue from residuals, rental of cookers, &c., 8·38d., leaves 1s. 6·88d., to which must be added the payment for interest and sinking fund, public lamps, &c., 7·4d.—making 2s. 2·28d., against 1s. 11·75d. for 1898-9.

RAMSGATE CORPORATION GAS AND WATER SUPPLY.

The Past Year's Working.

The accounts of the Gas and Water Departments of the Ramsgate Corporation for the year ending the 31st of March were considered at a meeting of the Gas and Water Committee held last Thursday—the Mayor (Alderman J. B. Hodgson) in the chair.

The minutes of the previous meeting having been read and approved, the recommendations of the Gas and Water Accounts Committee were submitted; the resolution being as follows: "That the sum of £2214 8s. 6d. from the gas revenue account and £1015 7s. 4d. from the water revenue account be paid to the district fund in aid of the rate to be made for the half year commencing Sept. 30, 1900."

Mr. C. J. Gwyn, J.P., the Chairman of the Committee, then proceeded to make his report on the accounts. He said they were of a satisfactory nature, and would probably need very little comment. The prices obtained for residuals had, as was the case last year, produced substantial returns, and had been an important factor in enabling the Committee to record as the gross profit for the year the sum of £10,362. Under the head of "manufacture," an increased amount of £2897 had been paid for coals and labour, &c., which had been fully accounted for on the other side of the balance-sheet. The charges incidental to the distribution of gas were £2190. This was more than in the previous year, due to the fixing of a largely augmented number of gas-stoves, as well as to an increase in the item for the repair, maintenance, and renewal of mains, &c. The make of gas exceeded that of the previous year by 21,941,000 cubic feet, or 11·11 per cent.; and 4,540,000 cubic feet of the increase had been sold within the Minster district, which was taken over by the Corporation on Jan. 1, 1899, though the gas was not supplied from the Ramsgate holders until June. The quantity of gas sold during the year, therefore, though only a short experience, justified the expenditure of the Corporation in the purchase of the Minster works. Last year he stated that the make was fast approaching 200 millions per annum; and, as a matter of fact, for that year it was 197,365,000 cubic feet. The 200 millions had now been passed; the total make for the present year being 219,306,000 cubic feet, including Minster. Without the Minster make, they would have reached 214,766,000 cubic feet; thus showing a substantial increase in the make of gas for Ramsgate alone—a result which had fully justified the foresight of the Committee in making provision to cope with increased manufacture. The net result of the year's working was £4714. In closing his report on the financial affairs of the gas undertaking, he called attention to the efficient condition of the works, many improvements in which had been made during the twelve months. The accounts of the water undertaking were not, he said, without interesting features. The gross amount received for water (less bad debts and empty houses), rent of meters, &c., stood at £10,890. On the other side, the revenue account showed an expenditure of £5131, which deducted from the receipts left a gross profit of £5759. After payment of dividend, stock redemption, and interest on temporary loans, there remained a balance of £1015. They had therefore, from the two undertakings, a sum of £5729. Having referred to the improvements effected in the plant during the year, he emphasized the necessity for proceeding soon with the extension of the headings towards Minster; adding that the recent succession of dry seasons would necessitate the greatest care if the district was not to be inconvenienced during the height of the season, when the requirements were heaviest. In conclusion, he said that what was weighing upon the minds of the Committee, as upon everybody else who had anything to do with gas undertakings, was the very serious increase which had taken place in the price of coal. Their contract fortunately had a little longer to run; but they would require a supplementary quantity of 10,000 tons to take them up to May. At the majority of places they had had to pay 10s. per ton advance, and at this price the profit from the gas undertaking would be shrunk to the amount of £5000. He had a list of 80 places where the price of gas had been advanced from 2d. to as much as 1s. 1d. per 1000 cubic feet. He hoped the Committee would endorse the recommendation of the Accounts Committee, which was that they should hand over a total of £3229 15s. 10d. in aid of the winter's district rate, and keep back £2500 of the gas profits against the £5000 which they were likely to be called upon to pay in the shape of the higher price for coal. They could then adhere to their present price of gas, and not raise it as other towns had been obliged to do. He thought it was very unwise to take such a step as increasing the price, as this would at once stop the consumption, and be a very unpopular thing at the best.

Mr. L. Hart, J.P., in seconding the proposition, said he considered the balance-sheet showed grand working for the year. They would not, he thought, find many works which would produce the amount of profit made at Ramsgate for this particular year. He was quite certain that it would be to the advantage of the town to keep the price of gas down as long as they possibly could.

Mr. R. C. Bear considered the profit earned was a very satisfactory one, but was no more than the ratepayers were entitled to; and, after carefully looking into the matter, he thought they should raise the price of gas, as had been done in other towns. He therefore proposed that the whole of the profits (with the exception of £714 to be added to the reserve fund) be handed over in aid of the district rate.

Mr. J. Barnett seconded this proposition; saying he considered it only reasonable that the present ratepayers should have the whole of the profit earned during the past year.

Other councillors, however, supported the Committee's recommendation.

Mr. Gwyn, in reply, said that to a certain extent he should be disappointed if the recommendation were not accepted, as, in conjunction with the Engineer (Mr. W. A. Valon, J.P.), he had given a great deal of thought to the matter. In most cases where the price of gas had been raised, they had no option in the matter; but here there was a way out of the difficulty.

The amendment was put to the vote; but it only received the support of the seconder. The recommendation of the Committee was thereupon adopted.

A vote of thanks having been accorded to the Chairman of the Committee (Mr. Gwyn), and briefly acknowledged, a similar compliment was paid to the Engineer.

Mr. Valon, in reply, said the Ramsgate works were a labour of love to him, and nothing rejoiced him so much as to find that everything was coming out right at the end of the year. It was to the good working of the whole of the staff, and to the assistance he received both from the Engineer's department (of which Mr. Arthur Valon was the head) and that of the Accountant (Mr. Cockburn) that the success of the concern as a whole was due. With regard to his Chairman, he thought there was not one in the world who could manage any concern better than he did.

OLDHAM CORPORATION GAS SUPPLY.

The Increased Price of Gas—Adoption of Water Gas.

At the last Meeting of the Oldham Town Council, Mr. Letham, in moving the adoption of the proceedings of the Gas Committee, called attention to the proposed increase of 3d. per 1000 cubic feet in the price of gas, and said he had the pleasure of submitting a few figures showing the result of the year's work. They had had a pre-eminently good year, the gross revenue reaching £161,614—an addition of £21,315. Of this sum, £5622 represented an augmented sale of gas. Then from residuals they had received the largely increased amount of £15,638. The gross expenditure had been £125,580; coal and cannel having cost £11,705 more than in the preceding year. Then they had paid £2000 more for wages. The gross profits were £36,023; and there was a net profit of £10,872. If everything had kept at normal prices—those of last year—he would have been in the agreeable position of being able to move a reduction of 2d. per 1000 cubic feet in the price of gas; but, instead of this, they had an advance in coal and cannel of, in round numbers, £34,000. They expected to get an increase from residuals of £5500, which would bring the advance down to £28,500. The Committee considered their position very carefully in view of raising this sum, and they had to remember that the gas-works were the property of the ratepayers and not of the consumers. They had to look at the matter from a business point of view, and they decided to recommend the Council to increase the price of gas 3d. per 1000 from the 24th of June. This meant only for nine months; so it would bring in but £11,600. Then they would have an available surplus of £10,900 on the basis of last year's working; leaving £6000 to be provided out of the profits in hand. He was glad to be able to congratulate the Council on having in its gas undertaking a department that was exceedingly well managed, and in a perfectly sound condition. He hoped the Council would accept the recommendation for an increase of 3d.; and he expressed the belief that they had that in the estimates which would enable them to tide over the difficulty, and, if they came out a little behind on the year's trading, yet have something in hand to enable them to pull through. The motion having been seconded, Alderman Waddington asked the Chairman of the Committee if they were going to have a report of the visit to London with regard to the water-gas plant; and, further, whether the Committee were taking into consideration the fact that this gas was far more detrimental than ordinary coal gas, and whether they intended to give the consumers notice of this. Mr. Letham replied that the report of the visit in question had been presented to the Committee, who had accepted it, and decided to go forward with the water-gas plant. With regard to the alleged detrimental character of this gas, a Home Office Committee had recommended that there must not be more than 25 per cent. of water gas introduced into coal gas. The Committee had no intention of adding more than this, but less. The minutes were then confirmed.

BOLTON CORPORATION GAS SUPPLY.

The Past Year's Working—The Allocation of Profits.

At the last Meeting of the Bolton Town Council, the proceedings of the Gas and Lighting Committee came up for confirmation. In moving their adoption, the Chairman (Alderman Miles) said it devolved upon him to ask the Council to approve of the annual balance-sheet of the department (*ante*, p. 1561); and in doing so he was proud to say that it had again passed through a very successful year. With regard to the all-important account known as the capital account, they had spent £8878 on absolutely productive works, such as new mains, meters, &c. This account, which had been so often criticized, now stood at the comparatively low sum of 13s. 10d. per 1000 feet of gas sold, as compared with £1 3s. 9d. at the time the works were transferred to the Corporation. With regard to revenue account, it was last year intimated in the Council that they were about to reduce the price of gas 3d. per 1000 cubic feet; and this reduction had taken effect for a whole year. If they had not sold any more gas, they would have been £11,000 the poorer; but he was glad to say this had not been the case, inasmuch as they had sold upwards of 52 million cubic feet more this year. Having done this, which represented about 6 per cent. of their turnover, the loss proved to be not £11,000, but £4574. This 52 million cubic feet was distributed among the consumers as follows: Large consumers, an increase of 20,320,000 cubic feet; prepayment consumers, an increase of 14,629,000 cubic feet; monthly consumers, an increase of 5,306,000 cubic feet; and ordinary consumers, an increase of 12,266,000 cubic feet. As against the loss they incurred by the reduction in the price of gas, they had this very gratifying result, that their residuals had produced £12,705 in excess of the year 1898-9. Coal had cost 1s. 5d. per ton more, adding £11,370 to the debit of their revenue account. After providing for all standing charges, they had a net sum of £20,000 to transfer to the relief of rates, or £5000 less than

before. In conjunction with this matter, he wished to draw attention to the following resolution which the Committee had passed: "This Committee desires to place on record its unanimous opinion that it is extremely undesirable to place, as has been done in the past, inordinately large sums out of their profits to the relief of the district rates of the borough; believing that such a course will inevitably interfere with, and cripple the success and prosperity of, the Gas Department." This resolution might, he said, sound a drastic one, and as if its object was to coerce the Council. But there was really no such intention behind it; and he suggested that the Council might, if they deemed it desirable, appoint a Committee or Sub-Committee to take the whole question into consideration, and decide to what extent the gas profits should be allocated in relief of rates. He must remind the Council that they were now losing a large number of consumers who were producing their own electricity, and who, while putting nothing into the coffers of the Corporation, were getting the full relief from these two profit-making departments—the gas and electricity supply undertakings. With regard to the current year, coal would cost them 5s. per ton more, which for 100,000 tons would mean an additional sum of £25,000. In view of this, it would not be possible to make £20,000 of profit unless they did something which they would gladly have left undone—viz., raise the price of gas. This was a matter which they would have to consider at the earliest possible moment. They could supply cheaper gas if they made it poorer in quality. It was of interest to note that there were now in use 10,500 grillers in cottage houses, 9500 prepayment meters, and 2500 gas cookers and fires. In regard to the incandescent system of gas lighting, he was glad to say that the price of mantles had been reduced by one-third, and that of the burners had also been cheapened. These ought to find a place in almost every cottage in the district. All that was required was that ordinary care should be exercised in their use. In conclusion, he paid a tribute to the heads of the department, and also to the staff, for the manner in which they discharged their duties.

In the discussion that ensued, Mr. W. H. Horrocks took exception to the resolution of the Committee with regard to the allocation of profits in relief of rates; and he proposed as an amendment that it should be eliminated. He pointed out that the Corporation enjoyed a monopoly in regard to the manufacture and sale of gas, and said it was their duty not to abuse it, but to supply gas as cheaply as possible to the ratepayers. He thought, however, that it could be readily shown that such monopoly was not abused, and that in places where private companies supplied gas it could not be obtained at the price which was being paid in Bolton. At the same time, it was to be remembered that in their case they were manufacturing on credit, seeing that their capital liabilities amounted to £688,067. Their credit was so good that they were enabled to get the money at £3 6s. 1d. per cent. The result of the last year's working gave them roundly a sum of £63,795. Deducting from this a sum of £13,816 for renewals, which was a very moderate allowance at 2½ per cent. upon the full amount of capital, the profit was brought down to £49,978. Taking from this the interest paid (£22,710), there was left a net sum of £27,267, representing the actual profit from the undertaking, or about 4 per cent. Working as they were upon credit, they should, in his opinion, afford all the advantage they could to the ratepayers, who formed the guarantors to the persons who lent the money. It certainly behoved them to keep down the rates as much as they possibly could, as an inducement to people to bring new undertakings into the town. A sum of £20,000 was not too much to ask the Committee to hand over in relief of the rates, and out of the remaining sum to set aside £2267 for the sinking fund, and £6623 as a reserve fund for the permanent reduction of the capital account. A suggestion having been made that this matter should be referred back to the General Purposes Committee, Mr. Walmsley expressed his agreement therewith. He said it was a matter which struck deep down at the root of rating. It must not be forgotten that since the extension of the borough they had taken in some partners, who were drawing about a quarter of the profit which formerly went into the central district. Instead of a decreased contribution, they should have an augmented one. It was eventually agreed to send this matter to the General Purposes Committee.

COVENTRY CORPORATION GAS SUPPLY.

Annual Report.

The Coventry City Council had before them last Tuesday the annual reports of the various Committees. That of the Gas Committee announced that the revenue for the year from all sources, including sales of gas, coke, tar, &c., amounted to £76,896, and the expenditure to £61,873. The amount at disposal was £15,632. Against this were charges amounting to £10,135; and this deducted from the gross profit left a net surplus of £5497. In view of the great rise in the price of coal and oil, the Committee deemed it desirable that the finances of the undertaking should be in a strong position. They therefore recommended that of the surplus profits £4000 be paid over to the general district fund, and the balance of £1497 be carried forward to the next account. They also recommended that the price of gas be increased by 2d. per 1000 cubic feet from the end of the current quarter; the rebates to large consumers remaining unaltered. This would make the price to the smallest class of customers 2s. 6d. within the city and 3s. without, and to large consumers 2s. 5d. and 2s. 4d. within the city, and 2s. 11d. and 2s. 10d. without.

Mr. Griffiths moved the adoption of the report; first referring to the retirement of Alderman Andrews from the chairmanship of the Committee, of which, however, he is still a member. Continuing, he said that on the whole, the results of the year's trading were fairly satisfactory. There was an increase in the quantity of gas made of 51,368,000 feet, which was equal to 10·18 per cent. The total amount of gas produced was 555,970,000 cubic feet; and this was the largest output the works had ever made. The total revenue from all sources was £76,895—an increase of £9173. The expenditure was £61,873—an increase of £8900. The gross profit was £15,022, to which had to be added interest on reserve fund £132, and amount carried forward from last year £476—making (with the shillings and pence) a total profit of £15,632. From this had to be deducted various charges amounting to £10,135, which left a net profit of £5497, compared with £4476 last year. The profits had been adversely affected by the prices of coal and oil and annexation. The cost of gas to the inhabitants of north-east ward was now the same as to those in the other parts of the city; whereas previously the Committee obtained an increased price from them for illumination. Annexation, therefore, had tended to reduce the profits. In connection with the new and old areas, he submitted figures relating to the last two years, which he thought would be interesting. In 1899 the gas consumed in the city by the large manufacturers paying 2s. 2d. per 1000 cubic feet was 175,607,000 feet; the figures for this year being 206,138,500 feet, or an increase of 30,000,000 feet. The quantity taken by the small manufacturers at 2s. 3d. was 12,761,200 feet in 1899, and 11,382,600 feet this year—a decrease of 1,250,000 feet. The third class of consumers, the ordinary householder, paying 2s. 4d., took 241,552,800 feet in 1899, and 263,826,100 feet this year; an increase of 22,250,000 feet. Outside the boundary, there were two rates—2s. 8d. and 2s. 10d. per 1000 cubic feet. In regard to the 2s. 8d., the quantity of gas consumed last year was 5,860,000 cubic feet, against 3,487,100 feet this year—a decrease of 1,500,000 feet. At 2s. 10d. the consumption last year was 21,817,700 feet against 12,338,600 feet this year—a decrease of 9,500,000 feet. There had been a large increase in the prepayment meters in use. The gas thus consumed had risen from 5,909,800 feet in 1899 to 11,286,500 feet this year—an increase of above 100 per cent. Referring to the increased cost of coal, he said the Committee were of opinion that the rise might last perhaps nine or ten months; and after that there might be a slight fall again. Coventry was an industrial city; and, therefore, they did not want to frighten away the trades and industries by putting the price of gas too high. During the past few weeks, fresh industries had come to Coventry; and therefore he thought it would be a wise policy on the part of the Council to adopt the suggestion the Committee had made of increasing the price of gas by only 2d. per 1000 feet all round. In view of the continued growth of the city and the increased demand that had been experienced for gas, it was absolutely necessary to proceed at once with the erection of new works on the site decided upon at Foleshill. A Sub-Committee had been appointed to deal with the matter; and the Engineer (Mr. G. Winstanley) had been actively engaged for some time on the preparation of plans. Preliminary negotiations for the purchase of land and arrangements for railway sidings were being carried on; and he hoped to bring the question in a tangible shape before the Council for approval at an early date. He desired to acknowledge the ability and attention which had been paid to the interests of the undertaking by the Manager and principal officials in keeping the supply equal to the demand during a very anxious time.

Alderman Andrews seconded the motion, remarking that the financial balance was above what had been expected at the end of the year. The Committee had exercised a wise discretion in recommending that the usual amount of £4000 be handed over to the rates, and that the remainder be carried forward. He would have been glad to have seen the increase in the price of gas postponed for another three months. The price of coal, in his judgment, was not certain to keep up; he thought it would fall again at no distant date. The quantity of gas used by the manufacturers in Coventry was enormous; and therefore the price could not be exactly fixed by any narrow views they might have about making profits. Their main object must be to keep the manufacturers in the city. The price of coal, reckoned on the average at an increase of 5s. per ton, would mean an increase of £10,000 in the cost of coal during the current year. Therefore, the policy recommended by the Committee, of carrying the balance to next year's profits, was a good one.

Alderman Tomson congratulated the Committee on having the courage to look matters fairly in the face, and upon making up their minds to an advance of 2d. per 1000 feet, well knowing they would not be able to produce gas at the rate they had done hitherto.

The report was adopted.

SELBY GAS UNDERTAKING.

A Successful Result for the Past Year—The Manager Complimented.

The past year's working of the Gas Department of the Selby District Council has given every satisfaction to that body; and when the annual statement was formally submitted to the members last Wednesday, the Manager (Mr. T. H. Alderson) and the Gas Committee were congratulated thereon. Commencing the year with an adverse balance of £57, the total receipts were £6033. Against this the working expenses were £3287; while salaries took away £259. After other expenses had been paid, there was a gross profit of £2287. Out of this, £2117 went for the repayment of principal and interest on loans; and after paying off the adverse balance, there remained a net profit of £112, which is carried to the reserve fund. In moving the adoption of the report, Mr. Scott said that, although during the past year they had to pay upon the same quantity of coal carbonized a sum of £160 extra, no advance was made in the price of gas, and the profits were £2287. From a financial point of view, the result was exceedingly satisfactory. He (Mr. Scott) regretted very much that the necessity had now arisen for an increase in the price of gas; but it could not be avoided. Coal would cost them £900 more than last year; and there would be a deficiency which he had no doubt they would realize out of the cost of residuals. In the report there was much that was satisfactory to the Council, and highly creditable to the Manager. The balance-sheet showed a profit at the rate of 8½ per cent.; and in regard to the loan, they had repaid £7320 of the principal.

The Manager afterwards presented the yearly statement, which showed that there was an increase in the quantity of gas made of 3,827,000 cubic feet; while there was an increase of 386 tons 13 cwt. in the quantity of coal carbonized at an increased cost of £229. The gas made per ton of coal carbonized this year was 10,273 cubic feet—a decrease of 90 cubic feet. The illuminating power was 17·96 candles. The quantity of coke sold was 1185 tons, which realized £605, against 910 tons realizing £458—an increase of 275 tons and £147. The amount of coke saleable per ton of coal carbonized was 7 cwt. 19 lbs.—an increase of 3 qrs. 21 lbs. per ton. The total receipts for residuals were £1179, against £820 the previous year—an increase of £359. The balance of loans on the gas-works on April 1 amounted to £27,405, and £360 has been added; this amount being obtained for new mains. From the sum named, £1420 has to be deducted; being repayment of principal due on March 31. This

leaves £26,344 still owing. The total amount of profit was £2287, equal to 8·34 per cent. interest on the capital employed. Mr. Scott remarked that, having heard the statement of the Manager, they would be convinced that the gas-works plant and all connected with it was in a very healthy and satisfactory condition from every point view. He moved—"That this Council, after hearing the financial and working statement of the gas-works read, congratulate their Manager on the highly satisfactory results obtained." Mr. Foster seconded the motion; believing it was the opinion of all the members that they had an excellent Manager. Mr. Alderson briefly acknowledged the compliment, and bore testimony to the excellent work rendered by all his staff. The coal storage was a matter that required attention before the winter came on; and he expressed a hope that the carbonizing plant might be improved.

NEATH CORPORATION GAS SUPPLY.

The Past Year's Working.

The Gas Engineer and Manager of the Neath Corporation (Mr. Robert Browning, Assoc.M.Inst.C.E.) has lately presented to the Gas Committee his report for the past financial year. It appears therefrom that out of the £75,500 borrowed on account of the gas undertaking, £44,411 has been repaid; leaving a balance of £31,089 now due. There was an expenditure of £8486 on capital account last year, including £6737 for new works. The gross profit amounted to £3798; being an increase of about £900 on the preceding year. In making a comparison, Mr. Browning points out that coal cost £328 more, due to the fact that upwards of 1000 tons more were carbonized; and wages (manufacture) £160 more, owing to the stokers' wages being higher and their hours shorter. There was an increase of £129 in wear and tear, due to additional work incurred during the extensions. Public lighting cost £100 more, consequent upon extra wages and expenses in connection with incandescent lighting. Altogether, there was an augmented expenditure of about £802, as compared with the preceding year. On the other side of the account, there was a very satisfactory rise in the gas and meter rentals, amounting to about £1439, most of which was attributable to private consumption. Residual products realized £413 more; and the total receipts were about £1700 more. Subject to the approval of the Committee, the balance of profit and loss has been appropriated as follows: After paying £1152 interest on loans and £73 at the bank, £200 has been placed to the depreciation fund account, which shows a debit balance of £76. A suspense account has been formed to deal with the expenditure on renewals of buildings, boilers, machinery, &c., which is chargeable to revenue—the amount being £1728, which is written off. A sum of £1512 is applied in reduction of the principal; leaving a balance of £4015 to be carried to the next account. In closing his report, Mr. Browning calls the Committee's attention to a few points. There is a debit balance of £1682 on the capital account, due to the ordinary expenditure; and he suggests that at the first opportunity they should apply for fresh borrowing powers, as they have none at present. All the new work, including the renewals, has now been completed; and with the exception of £76, the whole of the renewal of machinery, boilers, buildings, and also the cost of land lately purchased, amounting to £2500, chargeable to revenue, has been paid off out of the balance on the profit and loss and depreciation fund accounts. Mr. Browning expresses his pleasure in stating that all the extensions and renewals are giving every satisfaction. Although he has not had the benefit of a full year's working, the up-to-date plant has been productive of increased profit. Formerly, they used extra screened coal; but out of the 7200 tons carbonized last year, 6000 tons consisted of "through" coal, and the make of gas increased 400 cubic feet per ton, although large coal should show better results than "through." The illuminating power of the gas was kept to more than 1½ candles above the parliamentary standard (14 candles), without the aid of cannel or any other enricher. Mr. Browning reminds the Committee that, in common with others, they have had to pay a greatly increased price for their coal for the next twelve months, amounting to about £2400. He remarks that most gas undertakings are raising the price of gas, from 6d. per 1000 cubic feet upwards; and to meet the large extra expenditure the price at Neath should, he says, be raised at least 8d. But, owing to the foresight of the Committee, there is a disposable balance of more than £4000 to the credit of the profit and loss account, which is intended for use in emergencies of this kind.

GAS v. ELECTRIC LIGHTING AT HASTINGS.

At the last Meeting of the Hastings Town Council, the Public Lighting Committee reported that they had had before them reports from the Sub-Committee on Electric Light, on the subject of the desirability of lighting certain streets by electricity supplied from the works of the Corporation. The streets in question had been viewed by the Committee, and, in accordance with instructions, the Borough Electrical Engineer (Mr. L. Andrews) had submitted a report on the matter. He put the annual expense, charging for current at 1½d. per unit, at £676, as compared with £649, the present cost of gas. In addition, the lamp columns would come to £597; and the total estimated outlay would be £2205. The Committee recommended that application should be made to the Local Government Board for sanction to the borrowing of this sum; and that notice should be given to the Gas Company that the lamps which would be displaced by the scheme would not be required after the 25th of December next. A table was appended, giving the number and type of the existing gas-lamps, their annual cost, the number and size of the electric lamps proposed, the number of units of electricity used per annum, the annual cost of the suggested electric lamps, and the present and proposed illumination in the thoroughfares mentioned. The relative annual cost of the two systems has been already stated. The total light afforded by gas was put at 3484 candles, that which would be furnished by electricity at 20,100 candles. In a letter addressed to the Town Clerk (Mr. B. F. Meadows) by Mr. Chas. E. Botley, the Engineer and Manager of the Gas Company, he submitted the following points for the information of the Council, with the request that his letter might be read at the meeting when the lighting question came up for consideration: "(1) The present candle power of the existing gas-lamps is not correctly stated in the report, it being nearly double the figure given. (2) The existing gas-lamps, if fitted with incandescent burners (which are generally being adopted in preference to electric arc lighting), would give a candle power in excess of that claimed for the proposed electric lamps. (3) With the recent reduction in the price of incandescent burners and mantles, the extra illumination can be given without any increase on current rates, and without disturbing the roads or footways. (4) The large lamps at the Memorial, in Wellington Square, and opposite the Public Hall, as also the 'Whitehall' lamps and columns, were got specially to meet the desires of the Council; and they can be utilized to give any desired illuminating power at a minimum cost."

The adoption of the report was moved by Dr. Allfrey, who expressed the hope that it would be favourably received by the Council, notwithstanding Mr. Botley's letter. He said it seemed to him that the question of illuminating power was very much an academic one. The point really at issue was whether it would be to their advantage to adopt the electric light, now that they had the undertaking in their own hands, as generally as possible for the illumination of the streets. He considered the electric light much more suitable than incandescent gas-light; and as regarded cost, there was only a very slight difference. He thought they would find before long that, by using their own illuminant, they would gain very considerably. Mr. Stace seconded the motion. Mr. Boutwood said he thought it would be interesting to have the correct figures. Reckoned in the aggregate, the difference was between 3484 and 6267 candles. With the incandescent gas-light, the illuminating power would be 22,968 candles; whereas the proposed electric lighting would only furnish 22,100 candles. He considered it was strange that there should be such wide discrepancies in the figures. Mr. Bones moved, as an amendment, that the matter be referred back to the Committee. Dr. Culhane seconded the amendment. Alderman Langham objected to the report being sent back. He said the Corporation had spent money in acquiring works for the purpose of supplying the electric light to the public thoroughfares and for private purposes, and the report simply recommended that certain streets should be lighted, now that they had the cables down, by the electric current. Surely they were going to adopt electric light, or they would never have bought the concern. It was better to use their own property than buy gas from another source; and it must be more economical. If they were going to allow the interest on the money spent on the electric light undertaking to be idle, and not to earn money by illuminating their own streets, they had adopted a suicidal policy. Dr. Gray (the Chairman of the Gas Company), who was received with cries of "Order," asked, if a member of the Council saw incorrect statements put forth, on the authority of which they were to be called upon to act, was he to be prevented, by a so-called rule of "interest," from pointing them out? If he was, and assuming that the Council did not wish to act in ignorance, what was he to do? He told Mr. Botley that it was useless to send him figures, because he would not be allowed to say anything if he did. Mr. Botley put before them statements which they were entitled to prove; and he did so, not with the object of attacking anybody, but in order that the Council might not take a leap in the dark. In reply to Mr. Stace, the Electrical Engineer said his figures were ascertained from scientific facts. Dr. Allfrey having briefly replied, the amendment was lost by 18 votes to 3, and the report adopted.

The following is an extract from a letter on the above subject addressed by Mr. C. F. Botley, the Gas Company's Assistant Engineer and Electrician, in his private capacity as a ratepayer of the town, to a member of the Public Lighting Committee: "Electricity must be supplied at under 1d. per unit to compete, light for light, with incandescent gas; and the recent reduction of prices by the Welsbach Incandescent Gas-light Company renders the possibility of great developments in the latter direction. The candle power of an electric arc lamp can be given at anything in figures, for it varies from a miserable light to great brilliancy; whereas, of course, with a gas-burner it is possible to test it on a photometer, and know within a little the actual candle power. The figures given for the candle power of the gas-lamps are practically about half the actual; and as to this, it is either as I say or not, and can be easily tested. . . . If incandescent gas were used entirely in the streets proposed to be lighted electrically, more illumination would be obtained than from the electric lamps proposed, at the same, or probably reduced, cost, without the capital expenditure, and without pulling about the roads. The figure of 1¼d. per unit, besides ignoring altogether the wear and tear of the machinery, other than the lamps, is a ridiculous one; and I am particularly struck with the audacity of anyone bringing such a figure before a body of gentlemen supposed to possess some common sense. Such a cost might be obtained in coal-bearing districts under *ideal* conditions; but it is absolutely impossible in Hastings, and would not pay for coal alone. For coal, too, the Electric Light Department are likely to have to pay an advance of 8s. to 10s. per ton; and this too seems to be ignored. In the face of charges up to £52 per lamp per annum for the Front line, the present proposal is truly a fairy tale, and, as I have said, utterly impossible."

CHELSEA WATER-WORKS COMPANY.

The Half-Yearly General Meeting of this Company was held at the Office, Commercial Road, Pimlico, last Thursday—Mr. F. S. Clayton in the chair.

The Secretary (Mr. G. H. Gill) read the notice calling the meeting, and subsequently the certificate of the Government Auditor appended to the accounts, and the report of the Company's Auditors, who stated that they had "great pleasure in again expressing their entire satisfaction with the clear and precise way in which the accounts have been kept, the more so taking into consideration the constant increase of work in the Accountants' Department."

The Governor, in moving the adoption of the report, stated that, in the opinion of the Directors, it was satisfactory, though he would not say very satisfactory. The gross income for the half year ended March 31 last had been £86,805, being £2940 in excess of that of the corresponding period of the previous year; and the working expenses had amounted to £27,496, showing an increase of only £540. Considering that the period under

review was the Company's "lean" half year, this was a very satisfactory state of things; and it justified the Directors in recommending a dividend on the ordinary stock at the same rate as before—namely, at the rate of 11 per cent. The quantity of water pumped during the half year showed a slight increase as compared with the quantity pumped in the corresponding period of last year. The cost of pumping had been a little more, owing to the higher price of coal; and with respect to this subject, the Company, in common with the other Water Companies, would have to face a large advance of price under the new contracts to be entered into as from the present time. The Chelsea Company had just entered into another contract for twelve months, and at a very material increase in the price, which would affect them to a considerable extent—over £2000. The Directors, however, had no control over the matter. The only consolation was that it was an extra expense which he believed the Company were well able to bear without its affecting their dividend in any way. There had been 354 new supplies laid on during the half year, which were estimated to produce an additional water-rental of £1087; and 99 houses had been pulled down for improvements, entailing a temporary loss of income of £172. But there was no doubt that this would be more than compensated for eventually by increased water-rate, as it was found in practice that the old houses that were pulled down were replaced by others of a more important character. Since their last meeting, the Royal Commission on London Water Supply had issued their final report, which was altogether adverse to the claims of the London County Council, while dealing fairly, the Directors thought, with the Water Companies. Having read certain extracts from the report, he observed that it was impossible to state what course the Government might take in regard to it; but he thought it was quite possible that they might bring in a Bill next session to carry out the recommendations of the Royal Commission. The Bill promoted by the County Council for the purchase of the undertakings of the London Water Companies was rejected by a considerable majority on second reading; and the Council's other Bill, for acquiring the Welsh reservoirs and works, was consequently withdrawn. The London County Council had therefore been unfortunate all along the line this year. The proprietors might remember that the Company this session promoted a Bill, the object of which was to declare valid the creation and issue of the capital authorized in March, 1899. The Bill, in other words, was introduced for the purpose of confirming the issue of this stock in consequence of doubts entertained by the Government Auditor as to the legality of the proceeding. No doubt had been entertained on the subject by the Directors, who had felt confident that they had acted within their right; and after a lapse of nine months, the Government Auditor, who took legal advice on the subject, satisfied himself that his doubts had no foundation. He therefore signed the accounts which he had previously refused to sign, and there was thus no object at all in proceeding with the Bill, which was accordingly withdrawn. Another Bill was introduced by the Company jointly with several of the other Companies, the object of this measure being to confer further powers on the Local Government Board. This Bill had also been withdrawn; the Speaker having ruled that it should have been introduced as a public measure, and not as a Private Bill, as it sought to impose new duties on the Government. He was happy to be able to state that the works which the Company had had in hand, and which had been referred to in previous reports—namely, the construction of new service reservoirs at Putney Heath and the raising of the banks of the subsidence reservoirs at Molesey—were practically completed. The subsidence reservoirs were now quite full; and about a week ago the water was turned on in the new service reservoirs at Putney Heath. These two new works would constitute a very important addition to the Company's plant, and tend to the perfection of their system of water supply. They would have at Putney Heath 48 hours of filtered water always ready to hand; and the position of these service reservoirs was exceedingly good, being 175 feet above Ordnance datum. They were therefore able to supply their consumers by gravitation at a most excellent pressure, and they could supply all houses in Victoria Street, Westminster, without any difficulty. In fact, complaints of a short water supply from their mains were practically unknown at the office. He afterwards expressed the great regret of the Directors at the death, since the last general meeting, of their late colleague, Mr. William Peter Bodkin, who had been a Director of the Company for 43 years, and who had always taken an active interest in their affairs. In filling the vacancy thus caused, the Directors had considered it to be important, if possible, to select a candidate with a special knowledge of matters of finance; and they had been fortunate in meeting a gentleman of this character in Mr. Charles Henry Reynolds Wollaston, whom they accordingly elected a member of the Board. They felt satisfied that Mr. Wollaston's special knowledge of banking and finance would be of considerable service to the Company, in the near future, perhaps, as it might be that, sooner or later, their undertaking might be purchased. He also referred to the excellent services rendered to the Company by the Secretary, the Assistant-Secretary, the Engineers, and the entire staff.

The DEPUTY GOVERNOR (Mr. Jackson Hunt) formally seconded the motion.

Mr. BESLEY, Q.C., having alluded with satisfaction to the very prosperous position of the Company, and to the favourable report which had been issued by the Royal Commission, advised the Directors, in view of that report, to avoid spending further money on promoting Bills in Parliament. He thought that the time had arrived when resistance should be offered to the action of the coal masters in raising the price of coal to railway, gas, and water companies; and he said he thought that it might not be amiss if the Directors of the London Water Companies were to entertain the idea of confederation, for the purpose of buying collieries, which they could afterwards conduct on something of co-operative principles.

The motion was carried unanimously; and resolutions were afterwards passed approving the accounts, declaring the dividends recommended, and re-electing the retiring Directors—Mr. W. H. Yatman, Mr. Jackson Hunt, and Mr. Wollaston—Mr. Yatman being warmly congratulated on entering (as he now does) on his 51st year's service as a Director of the Company.

A vote of thanks to the Chairman and Directors was afterwards passed; and the proceedings then terminated.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 1719.

Issue.	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment	Issue	Share	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.	£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 11	10½	Alliance & Dublin 10 p. c.	20—21	..	5 0 0	60,000	5	Feb. 23	7	Ottoman, Ltd. . . .	5—5½	..	6 7 3
100,000	10	,,	7½	Do. 7 p. c.	13½—14½	..	5 3 5	500,000	100	June 1	6	People's Gas of Chicago } 2nd Mtg. Bonds .	102—106	..	5 13 2
800,000	100	Jan. 2	5	Australian 5 p. c. Deb. .	102—104	..	4 16 2								
200,000	5	May 16	6	Bombay, Ltd. . . .	6—6½	..	4 12 4	851,070	10	Apl. 27	7	River Plate Ord. . . .	10½—10⅝	..	6 10 3
40,000	5	,,	6	Do. New, £4 paid .	4—4¼	..	5 6 8	250,000	Stk.	Dec. 29	4	Do. 4 p. c. Deb. .	101—103	..	3 17 8
380,000	Stk.	Feb. 23	12	Brentford Consolidated	250—260	..	4 12 4	250,000	10	Apl. 11	8	San Paulo, Ltd. . . .	11½—12½	..	6 8 0
270,000	,,	,,	9	Do. New . . .	185—190	..	4 14 9	135,000	Stk.	Mar. 14	10	Sheffield A.	245—247	..	4 1 6
50,000	,,	,,	5	Do. 5 p. c. Pref. .	140—145	..	3 9 0	209,053	,,	,,	10	Do. B.	244—246	..	4 1 4
159,375	,,	June 14	4	Do. 4 p. c. Deb. .	116—120*	..	3 6 8	447,427	,,	,,	10	Do. C.	244—246	..	4 1 4
220,000	Stk.	Mar. 14	11½	Brighton & Hove Orig. .	230—240	..	4 15 10	5,600,000	Stk.	Feb. 23	5½	South Metrop., 4 p. c. Ord.	127—132	−1	4 0 9
226,320	,,	,,	8½	Do. A. Ord. Stk. .	175—180	..	4 14 5	1,520,000	,,	Jan. 12	3	Do. 3 p. c. Deb. . .	98—100	..	3 0 0
999,500	Stk.	Feb. 23	5	Bristol, 5 p. c. max. .	125—130	..	3 16 11	380,940	Stk.	May 16	5	Southampton Ord. . .	115—120	..	4 3 4
420,000	20	Mar. 29	10	British	39—41	..	4 17 7	70,825	,,	Dec. 29	4	Do. 4 p. c. Deb.	120—125	..	3 4 0
50,000	10	Feb. 23	12	Bromley, Ord. 10 p. c. .	24—26	..	4 12 4	120,000	Stk.	Mar. 14	6	Tottenham and } A. 5 p. c. B. 3½ p. c.	120—125	..	4 16 0
79,000	10	,,	9	Do. 7 p. c. . . .	19—21	..	4 5 8	250,520	,,	,,	4½		93—98	..	4 11 10
500,000	10	May 16	6	Buenos Ayres (New) Ltd.	9—9½	..	6 6 4	55,100	,,	June 14	4	Edmonton 4 p. c. Deb.	111—115*	..	3 9 7
220,000	Stk.	June 14	4	Do. 4 p. c. Deb. .	99—101*	..	3 19 3	182,380	10	Jan. 12	5	Tuscan, Ltd.	7—8	..	6 5 0
150,000	20	Mar. 14	8½	Cagliari, Ltd. . . .	24—26	..	6 6 11	149,900	10	Jan. 2	5	Do. 5 p. c. Deb. Red.	101—104	..	4 16 2
100,000	10	June 14	8	Cape Town & Dis., Ltd.	14—15*	..	5 6 8								
50,000	50	May 2	6	Do. 6 p. c. 1st Mort.	55—57	..	5 5 3								
550,000	Stk.	Apl. 11	13½	Commercial Old Stock .	289—290	+5	4 13 1								
236,425	,,	,,	10½	Do. New do. .	210—220	..	4 15 5								
288,237	,,	June 14	4½	Do. 4½ p. c. Deb. .	137—141*	..	3 3 10								
800,000	Stk.	May 31	9	Continental Union, Ltd.	155—165	..	5 9 1					WATER COMPANIES.			
200,000	,,	,,	7	Do. 7 p. c. Pref. .	170—175	..	4 0 0	780,399	Stk.	Dec. 29	11	Chelsea, Ord.	303—308	..	3 11 5
51,600	Stk	Feb. 23	14	Croydon A 10 p. c. . .	335—340	..	4 2 4	150,000	,,	,,	5	Do. 5 p. c. Pref. .	157—162	..	3 1 9
173,400	,,	,,	11	Do. B 7 p. c. . .	265—270	..	4 1 5	160,000	,,	,,	4½	Do. 4½ p. c. Pref. 75	145—150	..	3 0 0
555,000	Stk.	Feb. 28	5½	Crystal Palace Ord. 5 p. c.	116—120	..	4 7 6	175,785	,,	Mar. 29	4½	Do. 4½ p. c. Deb. .	145—150	..	3 0 0
60,000	,,	,,	5	Do. 5 p. c. Pref. .	130—135	..	3 14 1	1,720,560	Stk.	Apl. 11	7	East London, Ord. . .	192—196	..	3 11 5
486,090	10	Jan. 26	11	European, Ltd. . . .	19½—20½	..	5 7 4	654,740	,,	June 14	4½	Do. 4½ p. c. Deb. .	142—147*	..	3 1 3
354,060	10	,,	11	Do. £7 10s. paid .	14½—15½	..	5 6 5	390,000	,,	,,	3	Do. 3 p. c. Deb. .	97—99*	..	3 0 7
14,993,075	Stk.	Feb. 9	4 9/10	Gas- 4 p. c. Ord. . .	99—101	−2	4 17 0	700,000	50	June 14	7½	Grand 10 p. c. max. .	104—107*	+1	3 10 1
2,600,000	,,	,,	3⅞	light 3½ p. c. max.	96—98	..	3 11 5	310,000	Stk.	Mar. 29	4	Junction 4 p. c. Deb. .	130—135	..	2 19 3
3,799,735	,,	,,	4	and 4 p. c. Con. Pref.	116—118	..	3 7 10	708,000	Stk.	Feb. 23	14	Kent	307—312	..	4 9 9
3,993,975	,,	June 14	3	Coke 3 p. c. Con. Deb.	95—98*	..	3 1 3	160,000	,,	,,	7	Do. New, 7 p. c. max. .	200—210	..	3 6 8
70,000	10	May 31	8	Hongkong & China, Ltd.	13½—14½	..	5 10 4	1,043,800	100	Dec. 29	10½	Lambeth, 10 p. c. max. .	290—295	..	3 11 2
2,800,000	Stk.	May 16	10	Imperial Continental .	203—208	−1	4 16 2	406,200	100	,,	8	Do. 7½ p. c. max. .	207—212	..	3 15 6
473,600	Stk.	Feb. 9	3½	Do. 3½ p. c. Deb. Red,	100—103	..	3 8 0	850,000	Stk.	Mar. 29	4	Do. 4 p. c. Deb. .	130—133	..	3 0 2
75,000	5	June 14	6	Malta & Medn., Ltd. .	4½—5*	..	6 0 0	500,000	100	Feb. 23	13½	New River, New Shares	422—427	..	3 3 2
560,000	100	Apl. 2	5	Met. of 5 p. c. Deb.	107—110	..	4 10 11	1,000,000	Stk.	Jan. 26	4	Do. 4 p. c. Deb. .	132—137	..	2 18 5
250,000	100	,,	4½	Melbourne 4½ p. c. Deb.	106—108	..	4 3 4	902,300	Stk.	June 14	7½	South-wark and } Ord. . . . 7½ p. c. max. . 5 p. c. Pref.	195—200*	+2½	3 15 0
541,920	20	May 31	3½	Monte Video, Ltd. . .	10½—11½	..	6 1 8	126,500	100	,,	7½		182—187*	..	4 0 3
667,946	Stk.	Feb. 23	9½	Newc'tle & Gatesh'd Con.	215—220	..	4 4 1	489,200	Stk.	,,	5		157—162*	..	3 1 9
299,855	Stk.	Dec. 29	3½	Do. 3½ p. c. Deb. .	104—107	..	3 5 5	1,019,585	,,	Apl. 11	4	Vauxhall 4 p. c. A Deb.	129—134	..	2 19 9
160,000	5	May 16	8	Oriental, Ltd. . . .	7—7½	..	5 6 8	1,155,066	Stk.	June 14	10	West Middlesex . . .	280—285*	..	3 10 2
135,000	5	,,	8	Do. New, £4 10s. pd.	6½—6¾	..	5 6 8	200,000	,,	,,	4½	Do. 4½ p. c. Deb. .	145—150*	..	3 0 0
45,000	5	,,	8	Do. do. 1879, £1 pd.	1¼—1⅝	..	4 11 5	200,000	,,	Mar. 14	8	Do. 8 p. c. Deb. .	99—101	..	2 19 5

* Ex. div. *Ex div.

NEW YORK WATER SUPPLY.

An Important Report.

It may be remembered that an effort was made last year to introduce into New York a supplemental supply of water furnished by the Ramapo Company. We noticed the matter in the "JOURNAL" for the 2nd of January last (p. 39), when we quoted the opinion expressed on the proposal by our contemporary the "Engineer," which was to the effect that the most advantageous course was for the city to provide its own water supply. In the result, the Company's project failed through the energy of Comptroller Bird S. Coler. Reports made by engineers to him showed the desirability of more reliable and comprehensive information than could be obtained from the municipal records, so he engaged Mr. John R. Freeman to make a study of the present sources, the merits and demerits of the Ramapo scheme, the amount of waste and its prevention, and the value of the present supply for fire protection. Mr. Freeman began his work last August, and continued it with all possible despatch till quite recently; calling to his aid a staff of experienced assistants and the resources of the Cornell Hydraulic Laboratory, where experiments of the highest engineering importance were carried out to determine the flow of water over the crest of the old Croton dam. The results of these studies have just been made partially public in a report of great value to engineers and others interested in municipal water supply; and the following summary thereof has been given in the "Engineering Record."

It has been found by careful computation of the records of the daily flow and waste of the Croton River during the past 32 years, and by comparison with the measured run-off from similar watersheds, that although the consumption will very soon be uncomfortably close to the safe limit, with prudent management and moderate and practicable restriction of waste the Croton watershed, supplemented as now by the Bronx and Byram watersheds, can furnish a safe and ample supply for the boroughs of Manhattan and the Bronx for four or five years to come; thus giving a short, but adequate, time in which to build works for an additional supply. The necessary surveys and steps towards the acquisition of an additional supply on a comprehensive scale, capable of ultimately yielding at least 500 million gallons per 24 hours (and preferably 750) should be begun within 90 days, so that construction may be commenced early in the spring of 1901.

While there is ample proof that more than half of the water now delivered by the aqueducts is wasted, the total consumption of water, including waste, in New York and Brooklyn is to-day smaller than in Boston, Philadelphia, Washington, Buffalo, Albany, Pittsburg, Chicago, Cleveland, Detroit, Denver, and certain other large American cities; and it appears plain, from reasons given later, that the hope of restricting waste does not justify delay in making sure of an adequate extra supply. If there has to be delay in securing a moderate additional quantity, from legislative or legal causes, then a thorough system of waste prevention, beginning properly with a meter on every domestic service, must of necessity be begun at once, or danger of a water famine invited.

In estimating the yield of the Croton watershed, various errors were discovered in the records. As the latter are extensively used by engineers, it is interesting to notice how the lack of accuracy occurred. The yield is determined by ascertaining (1) the quantity wasted over the old Croton dam, (2) that drawn through the old aqueduct, (3) that drawn through the new aqueduct, and (4) that drawn from the storage reservoirs to augment the natural flow of the streams, or *vice versâ*. The two parts of the old Croton dam are of a peculiar form, upon which no accurate experiments were ever made to determine the discharge at a given depth by the gauge. In the earlier estimates, an old formula of Eytelwein's was used for computing this quantity, and was assumed to be sufficiently correct. The accurate determination of how much water had wasted over the old dam day by day for all these years is of great importance in the present discussion, because it is only by holding back, in storage reservoirs, water like that hitherto wasted that the yield of the Croton in time of drought can be increased. Full-scale models of the Croton dam-crests were constructed in the Cornell University experimental canal, from careful measurements of the actual dams; and accurate and extended experiments upon the quantity of water discharged over them at various depths were made by Professor Williams. From these measurements, it appears that the earlier estimates of the quantity going to waste over the Croton dam were about 8 per cent. too large.

The earlier estimates of the flow through the old Croton aqueduct were based on the assumption that the coefficient of flow in this aqueduct—from thirty to fifty years old, and more or less obstructed—was the same as that in the new smooth and clean Sudbury aqueduct. New gaugings of the old aqueduct were accordingly made with various depths of water by using the current-meter designed by Messrs. Fteley and Stearns, with which the gaugings of the Sudbury aqueduct were originally made. These gaugings, and a study of all the available data, indicate that the earlier estimates of quantity drawn through the old aqueduct, when full, are about 14 million gallons per day too large.

The flow in the new Croton aqueduct had not been gauged since April, 1893; and in all previous estimates of consumption and yield it has been assumed that the delivery in gallons for a given depth of water continued substantially the same as when the aqueduct was new. A new gauging was made by the same engineer who carried out the original gaugings in 1891, 1892, and 1893, using the same instrument, and was repeated on four different days to ensure accuracy. The current-meter was rated again independently; and various comparisons leave no doubt of the accuracy of this measurement. It shows that the original carrying capacity has been impaired 15 per cent. This is equivalent to about 38 million gallons per day with the water at the usual depth. An error in a gauge was also discovered which had led to an over-estimate of 4 to 10 million gallons daily since the gauge was set.

In the former estimates, it was found that in the earlier years no allowance whatever had been made for effect of storage; and in the later years only a part of the storage reservoirs had been allowed for. This affected the estimates of the possible yield of the watershed in ways discussed fully in the complete report.

The rainfall records at all the stations in the Croton watershed were

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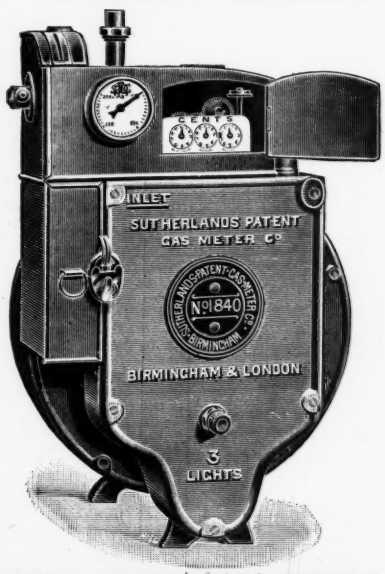

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also investigated and compared, and the estimates of the Croton yield confirmed by what has been found in other watersheds having substantially the same rainfall. The rainfall on the entire Croton watershed, from 1868 to 1899 inclusive, is found to have averaged 47·83 inches per annum. The average equivalent depth of run-off over the entire watershed was 22·93 inches per annum. The run-off has averaged 47·94 per cent. of the rainfall.

Summing up the final results of the new estimate of the Croton yield, the estimates of run-off month by month from 1870 to 1895, published in the Aqueduct Commissioners' report, average about 10 per cent., or 38 million gallons per day, too much. From a careful analysis and comparison with the observed run-off from the Croton, it appears that the safe yield of the Bronx and Byram sources combined is only from 15 to 17 million gallons, instead of 20 millions, as commonly claimed.

In the year 1899, the consumption throughout the boroughs of Manhattan and the Bronx averaged 116 gallons per inhabitant per day. Out of this, the needless waste averaged at least 50, or more probably 70, gallons per inhabitant; while the incurable or necessary waste very likely did not exceed 10 gallons. With a meter on every tap—domestic, public, and commercial—and with mains, service-pipes, and hydrants thoroughly overhauled and put into as good condition as the average pipe in the streets of Fall River, and with meters frequently tested to detect under-registration, and with a careful investigation of leaky plumbing and prompt repairs, probably New York would be better served than it is now, and have greater pressure in its pipes with a supply of 56 gallons per inhabitant per day than it has with 116 gallons; and 20 gallons more would cover all uncertainties.

The hydraulic and engineering features connected with preventing the above 70 or 56 gallons of waste are not doubtful or unduly expensive; but they would require a series of years for their full application. The real difficulties about saving the water wasted rest in human nature, and are questions of getting the voters to understand the truth of the matter—questions of public sentiment, politics, and good government. From studies in the result of efforts at waste prevention in other large cities, and from inquiry made among well-informed men as to the present sentiments of the New York public regarding domestic meters, Mr. Freeman is led to believe that for the immediate future these difficulties are insurmountable, and the hope of a cure for any large part of the waste is very remote. With all of its present waste, the domestic supply of water costs the average citizen (man, woman, and child) of Manhattan and the Bronx only $1 per head per annum. Water is so cheap that the average American citizen unfortunately seems better content to buy more than to save or conserve what he now has. The consumption of water (including waste) per inhabitant is not greater in New York than in the other large American cities. It is, in fact, to-day smaller in New York and Brooklyn than in most other large towns in America. There has been a tendency in many recent discussions to exaggerate New York's rank among other cities in wastefulness of water, and to overestimate the saving that can be made because of an apparent failure to appreciate that the real obstacles to reform are grounded in human nature and not in hydraulic engineering.

Ten days' continuous observations were made under Mr. Freeman's supervision during mild weather in December on the varying height of water in all three of the Central Park distributing reservoirs. Four observers, working in 12-hour shifts, measured the height once in six minutes throughout the 24 hours, by means of a hook gauge set in a still-box shielded from the wind, with such precision that the comparative depth of water at any time was known within a very few thousandths of a foot. The entire delivery of water to Manhattan was coming through the new aqueduct, which was carefully held at a constant depth, without appreciable variation, for two weeks. These reservoirs served as equalizing basins, and the variation in the rate of draught through the city at different hours caused the reservoir level to rise by night and to fall by day. The excess of consumption over the aqueduct delivery, or the reverse, during any hour, was shown by the precise measurements of the increase in depth of water in the reservoirs; and by computation it was found, from these observations of reservoir height and aqueduct flow, easy to determine the rate of consumption during any hour of the day or night. Day after day the observations repeat with remarkable uniformity—reaching their maximum at 10 o'clock in the forenoon, dropping off a little from 11 to 1 p.m., rising again slightly at 2.20 p.m., falling off rapidly after 5 to 6 p.m., decreasing further after 10 p.m. until the minimum was reached about 3 or 4 a.m.; the draught until that time being kept up by the refilling of the house-tanks, &c. Night after night the rate of consumption at 3 to 4 a.m. did not fall below 90 gallons per inhabitant per 24 hours—averaging about 94 gallons; while the highest point reached during working hours averaged at the rate of 137 gallons per inhabitant per day. Thus the excess of consumption in the most active hour of the day was only at the rate of 43 gallons per inhabitant per 24 hours over that in the quietest hour of the night. The average of the whole 24 hours was only 21 gallons per inhabitant greater than the draught at 3 a.m.

Late on Sunday night or early on Monday morning we should naturally expect the consumption to be at its minimum, for at that time domestic use is practically *nil*, house-tanks will have nearly all become refilled through the higher pressure of Sunday, and the factory-tanks will also have become refilled; and almost the only legitimate use that can be imagined after Sunday midnight is that of the water required for the comparatively few newspaper offices, the filling of boilers for steam heat in some few buildings, a small quantity for electric light stations, and a little for hospitals or an infrequent household in which there is sickness, and for a house-tank here and there which has not had time to become entirely replenished. After midnight, from 1 to 4 a.m., the record on Monday, Dec. 11, 1899, almost exactly reproduces that on Monday, Dec. 4, in showing a draught at the rate of 95 gallons per inhabitant per day at this hour, when the legitimate use of water should be at its minimum. Granting that this measurement was correct, the simplest common sense shows that a large part of this large draught from the reservoirs at this quiet hour of the night must have been waste through defective plumbing, leaky street mains, and abandoned service-pipes; and making the greatest reasonable allowance for uncertainty in measurement and for legitimate use at these hours, we are

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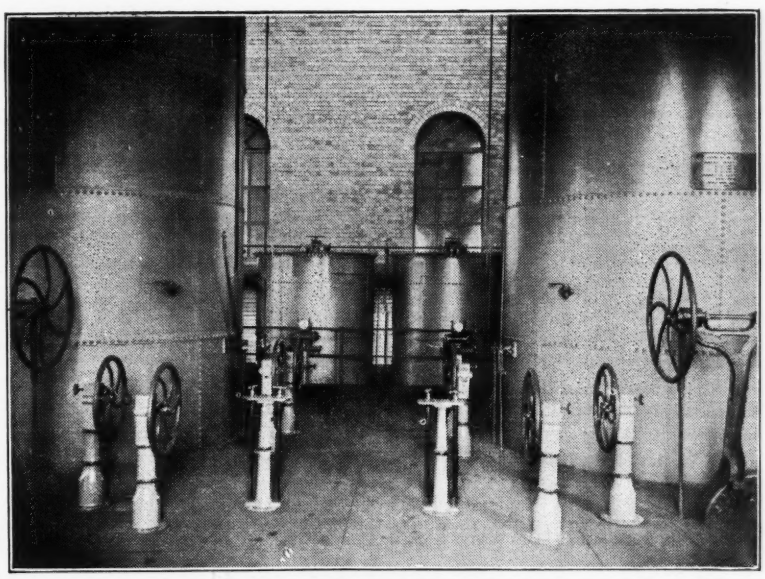

RESULTS PROVE EFFICIENCY.

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forced to conclude that water was running to waste at night at the rate of 80 gallons per inhabitant per 24 hours. A part of this waste must be regarded as incurable; for, with the very best of pipe laying, it is found that the small undiscovered leaks in the thousands of joints, aggravated more or less by expansion and contraction under temperature changes and by settlement of the earth around the pipe, cause waste which in the aggregate is considerable.

In the city of Fall River, which has the distinction of water-works the most thriftily managed of any of equal size in the United States, and where there is a meter on substantially every tap, and where close account is also kept of the water used for fires, flushing of streets, and so forth, the discrepancy between the water pumped into the mains and that shown as taken out of the mains by the aggregate readings of all the service meters, and after making allowance for the under-registration of meters, has not been brought below 6 gallons per inhabitant per day. In Woonsocket (R.I.), another thoroughly metered manufacturing city, with a population of about 28,000 supplied, the total water unaccounted for between the pumps and the service meters was 8·5 gallons per inhabitant per day in 1898, and 7·8 gallons in 1899. In two small districts of Boston, very thorough work for about eighteen months with the Deacon system brought a night consumption of 40 gallons down to a rate of 10 gallons per inhabitant per day. Under equal quality of pipe laying and caulking of joints, the waste from joints in cast-iron mains should be proportional to the aggregate length of these leaded joints; and the service-pipe leakage between the mains and the cellar wall should be proportional to the number of pipes. Computation shows that the population along the New York distribution pipes is so much more concentrated than in any other American city that the waste per head from joint leakage in the mains ought therefore to be very much less than is found elsewhere. For example, it appears that the total number of pipe joints in Manhattan is not far from 350,000, and that the length of leaded joints is not far from 1,250,000 to 1,500,000 feet; or, at most, there is only about 0·7 foot of leaded pipe joint per head in Manhattan and the Bronx, while in Fall River a similar computation shows 1·1 feet, and in Providence 2·7 lineal feet, or 4½ times as much as in New York. The number of service-pipes per 1000 inhabitants is only about one-half as great in New York as in certain fully metered cities, like Providence, Fall River, Worcester, and Woonsocket, in which the consumption of water is less than one-half that in New York. Therefore, from what has been accomplished in various cities, and from some experience in testing long pipe-lines subject to no draught except that of leakage, we might fairly expect that this necessary or incurable waste in New York could be reduced to 5 gallons per inhabitant per 24 hours. But, under the badly crowded and frequently disturbed condition of the ground beneath the streets, and with the increasing danger of corrosion by electrolysis and the inconvenience of searching for leaks, a safer figure for the incurable waste in mains and service-pipes in the streets, outside the cellars, appears to be 10 gallons per inhabitant per day.

In the report of Mr. Dalton, the Water Commissioner, for 1898, it is stated that the present meters in Manhattan and the Bronx (35 to 42) "cover every place where water is used to any considerable extent for other than domestic purposes." A careful analysis of the figures furnished by the Water Register, together with those from the Bureau of Arrears, show that for several years past the consumption of metered water in proportion to the total population of Manhattan and the Bronx has averaged 24 gallons per inhabitant per day. There is doubtless some under-registration in the meters with the present system of ownership and repair; but it appears fair to consider this offset by the metered water drawn in hotels, apartment houses, and certain large residences, which should fairly be charged to domestic service. This 24 gallons per inhabitant covers the use of New York's shipping, manufacturing, tall office buildings, electric stations, and a large part of the transient population. The explanation of the small figure may be that, dividing the quantity by the enormous population of 2 millions or more, makes the figure per head unexpectedly small. If from the measured delivery of the aqueduct, averaging 116 gallons per inhabitant per day, we deduct the metered flow for manufacturing and commercial purposes—24 gallons per inhabitant per day—and deduct the probable waste, curable and incurable, assumed to be at least 80 gallons per inhabitant per day, it leaves for the real domestic use, apart from waste, the surprisingly small figure of 12 gallons per inhabitant per day. This figure is not at all absurd in the light of a daily metered consumption of 11·2 gallons at Fall River, 16·3 gallons at Lawrence, 14·1 gallons at Woonsocket, and 14 gallons at Worcester.

(To be continued.)

The Price of Gas at Paignton.—In consequence of the increase in the price of gas, the Paignton District Council decided last Thursday that the public lamps should not be lit on the three nights before and the four nights after full moon, and that they should be lit half-an-hour later than hitherto and extinguished by eleven o'clock at night.

Sales of Shares.—At a recent sale by Messrs. Llewellyn Puttock and Co., of Gosport, £25 shares in the Gosport Gas Company realized £44 apiece, and original stock of the Gosport Water Company £25 10s. and £51 per £10 and £21 lot. Last Thursday at Blyth, Messrs. R. & W. Mack offered by public sale £10 fully-paid "A" shares of the Blyth and Cowpen Gas Company, to produce £9042 5s. for extensions and improvements. The existing original capital of the Company is £17,500; and the additional capital "A" shares £10,957 15s. It was for the purpose of increasing the "A" shares to £20,000 that the sale was held. The prices secured varied between £15 and £15 12s. 6d. per share. At a sale by auction at Alcester on Wednesday, shares in the Alcester Gas Company produced £116 and £117 apiece, and in the local Water Company £5 each. At Luton yesterday week, £7000 of new consolidated ordinary stock in the Luton Water Company, bearing a maximum dividend of 4 per cent. was sold at good prices. Lots of £50 stock were knocked down at £58 each, and lots of £100 stock reached £116 5s. On Tuesday there was exposed for sale by auction in the Town Hall, Coatbridge, 500 new shares of £10 each (bearing interest at 7 per cent. per annum) in the Coatbridge Gas Company. The prices secured ranged between £14 8s. 6d. and £14 11s.

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NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Still upward continues to be the progress of the Edinburgh and Leith Gas Commission, the accounts of which for the year ending May 15 have just been issued. The revenue of £297,225 is £30,471 more than in the year 1898-9. The price of gas was the same in both periods—3s. per 1000 cubic feet. But the sale of gas exceeded that of the previous year by no less than 91,028,700 cubic feet; and the revenue from sales of gas (£256,524) was greater by £13,924. The return from coke, &c. (£13,195), is an increase of £7342; and that from tar and ammoniacal liquor (£26,702) is an increase of £9126. The total expenditure was £227,767, which was £19,258 more than in 1898-9. The largest increase was upon coal, the cost of which amounted to £103,231, or £18,716 more than in the preceding year. The quantity of coal used was 161,383 tons, or 7372 tons more. Of oil there was 3253 tons used, an increase of 914 tons; and the cost was £9969, or £1473 more. The total charges for manufacturing gas amounted to £132,271—an increase of £25,605. Distribution cost £20,286, or £4882 less, which was entirely due to a lower expenditure upon the repair and maintenance of pipes and meters. Management cost £8841, or a decrease of £91. Feu-duties, rates, and taxes amounted to £9911, which was a decrease of £2088. Pensions and allowances came to £917, or £119 more. Accidental damages were £9, or a decrease of £6. Were it not for the great rise in the price of coal, the business of the Commission would be in every way in a most satisfactory position. As it is, it is in all respects most healthy, and is only temporarily inconvenienced by the increased cost of coal.

It is not often that anything so wicked is said in the Glasgow Town Council as was said on Wednesday, when the coal contracts were being fixed. The statement of Mr. R. M. Mitchell, the Convener of the Gas Committee, was concise, clear, and interesting. The Corporation are about to extend their oil plant at the Temple Gas-Works, with a view to keeping down the cost of producing gas. Mr. Foulis's system is a pure oil-gas process, and not a carburetting one; neither does it embody the principle of fractional distillation. It has been working for a few years; and its extension now is evidence that it has given satisfaction. Then the Gas Committee are to meet a Committee of their men, to discuss complaints regarding undue dismissal. This is an important step; but it is not necessarily, as was assumed by one speaker, the removal of what threatened to be a deadlock between the Committee and their men. When the conference takes place, it may be found to be the cause of a greater difference than would have arisen had the conference been refused. But I do not really anticipate that. It is to be a conference with the men, and not with the representatives of any Union; and the valour of the men will not be so vigorous in the committee-room as it is on the platform. It is more than likely that the workmen will leave the room convinced that they have been under a misapprehension. In that case, if it were given out by the Committee that they could not entertain any more complaints of a like nature, and that the incident was not to form a precedent, no harm would follow this concession to the men. In any view, the fact that the men are to be admitted to the presence of the Committee is proof that the Committee have no desire to do otherwise than rightly by their workpeople. What I have spoken of as wickedness came out in the remarks upon the coal contracts. It is suggestive of something which is not apparent to everyone—that the malcontents were all of the section favouring Socialism. In fact, I hold it as suggestive of this—that it was only another attempt to discredit the Gas Committee in the interests of Unionism. One member, who is a notorious Union man, remarked openly that it was time some of the old Conveners of Committees should be replaced by younger men. Then it was said that the Corporation were paying more for coal than were the Edinburgh Gas Commission; and the insinuation was thrown out that this was because of Mr. R. M. Mitchell's connection with the coal trade. I daresay none of these things were meant to be taken seriously in the Council; but outside it may be a different matter. A cry of corruption goes a long way with the electors; and some who are at present members of the Gas Committee may, unless they are specially plausible to the Union cause, find their seat endangered. That is the reading I put upon the movement. What is more, I expect that it will be renewed; and the first occasion will probably be when the report is submitted of the conference with the men. Unless it should be to the mind of the Union leaders, a few insinuations of undue influence or the like may be looked for. If it were mere ebullition, there would be little to complain of, beyond waste of time. But I am convinced that there is an ultimate object—the influencing of the electorate—in the doings of these men; and therefore I look upon them as not having a good effect upon municipal life.

Mr. Fleming, the Treasurer of the Glasgow Corporation Gas Department, reports that the gas-rental collected since the financial year began has amounted to £392,699, or an increase of £10,822 upon the collection in the corresponding period of the previous year. The receipts from residual products for the ten months have been £177,405, or an increase of £42,894.

The Dundee Gas Commissioners held their annual meeting on Wednesday last, when Treasurer Ritchie presented the accounts for the year. A summary has been given in these "Notes;" and I take up the Treasurer's statement at the point where he said it was gratifying to find the sale of gas was on the increase, notwitstanding the increased popularity of the electric light. He proposed that the price of gas be advanced from 3s. 4d. to 3s. 10d. per 1000 cubic feet. The main reason for the large increase was the unprecedented advance in the price of coal. Continuing, he said the structural changes and improvements could not be placed at less than £60,000. He pointed out that the chief reason why the price of gas was higher in Dundee than some other cities and towns in much the same circumstances as themselves, was the great disproportion between the sum they required to devote to the repayment of capital and interest and that of other towns. A much greater disproportion existed between their capital and their revenue than existed in other cities and towns. Were their capital in proportion to Glasgow, then their price would be 7d. per 1000 cubic feet less; and it would be 4d. per 1000 cubic feet less were their capital in proportion to that of Edinburgh, Aberdeen,

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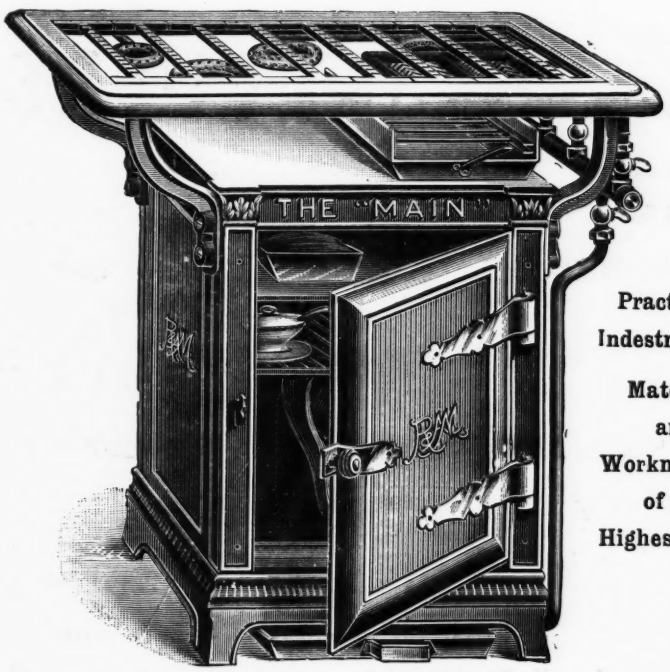

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Greenock, and Paisley. Concluding, Mr. Ritchie said the price of gas could not be properly reduced until the capital account was much lower than at present. It was this which led him to make certain proposals a year ago, and the same consideration compelled him to urge them to continue the policy so that they might bring their capital more in line, as in other towns, with their earning capacity. Ex-Provost Brownlee took exception to the increase in price. He said that since 1870 the sinking fund had repaid £179,178; and if the sinking fund had been £7500 from the beginning, as it should have been, the additional sum paid would have been £74,750, and the capital would have been reduced by £253,878. Consequently, they must see that the operation of the £7500 was amply sufficient and able to keep down the capital account. The items he objected to were interest on sinking fund, contingent fund, and the reconstruction of the gas-works; the total being £8520. They would thus see that if they took £8520 from the accounts, and the sum of £7500 entered into the estimates, they would have a total of £16,020, all beyond the statutory requirements; and from this they had to deduct the deficit of the year of £1479. This brought out a sum of £14,540, which was as near as might be equivalent to 6d. per 1000 cubic feet on the price of gas. If they adopted the policy he had indicated, they would not require to raise the price of gas at all. What he said was that the circumstances were greatly changed, and so unusual that they were warranted in considering whether it was prudent to burden the gas consumers of to-day, in the present state of the coal market, with such a heavy increase in price and such an uncalled-for repayment of capital. The gasholder was estimated to cost over £30,000. This was a provision for futurity; and why should the gas consumer of to-day be called upon to pay for that in a period of ten years? The thing was monstrous and oppressive. He moved disapproval of the items he had mentioned, and that the price of gas remain at 3s. 4d. per 1000 cubic feet. A proposal was made that the price be 3s. 7d. Treasurer Ritchie's motion was adopted, in the final vote, by 14 to 8. In all well-regulated communities this would have been accepted as decisive; but there appear to be public men in Dundee who are not prepared to accept finality unless it is according to their view. It is announced to-day that, being dissatisfied with the figures which were given on Thursday, a number of members visited the gas-works. The gas annuities stand at £225,000; and the object of the visitors was to discover what was represented by the £170,000 of capital beyond that. "Most of them," it is said, seemed to be "of opinion that the plant had been very highly valued, and that there was little chance of anything like £170,000 being obtained for it, if placed on the market." This is scarcely fair. Even assuming the gentlemen to have been expert valuators, they are very poor logicians if they expected that the gas-works plant could realize its value if placed on the market, apart from the use to which it is put as an integral part of the lighting of Dundee. But it is not so much the result they have arrived at, as the bad taste of their action, which is complained of. I should have expected that, when an effort was being made to write down capital, so as to place the gas undertaking on a sounder financial basis, everyone would have been willing to undergo some temporary inconvenience. Should the price of coal come down soon, the Commissioners will be in a good position at once; and to have changed a policy recently adopted, because of one bad year, would not be conducive to the prosperity of the undertaking.

The ceremony of laying the first plate of a new gasholder at Denny was performed on Monday, by Provost Ferguson, the Chairman of the Gas Commissioners. The holder is to be of 60 feet diameter and 40 feet in depth, having a capacity of 115,000 cubic feet. It is to be constructed so as to be capable of being telescoped. The cost is to be about £3500. Mr. J. M'Gilchrist, of Dumbarton, is the Engineer; and the Contractors are the Barrowfield Iron-Works, Limited. Ex-Provost Shanks, of Denny, was presented with an ivory mallet, as a memento of the occasion; and in returning thanks for the gift, he called to mind that it was nigh forty years since he first became interested in the gas supply of the burgh, then in the hands of two Companies. Those present were afterwards entertained to luncheon in the Railway Hotel.

The Edinburgh Association of Science and Art paid a visit last night to the works at Bonnington, Leith, of Messrs. D. Bruce Peebles and Co. They were first shown the gas department, where the processes of manufacture of meters, burners, and governors were seen at work. Then the electrical department was visited. This has been recently developed, under the supervision of one of the sons of the late Mr. D. Bruce Peebles, and is now producing large quantities of electrical appliances. All the machinery in the works is driven by electric motors, of which there are fifteen, varying from 3 to 15 horse power, at work.

The death of Mr. J. Robb, of Haddington, referred to in another column, removes the oldest gas manager in Scotland. He was also the second of the honorary members of the North British Association of Gas Managers who have died since the Association met in July last; the other having been Mr. D. Bruce Peebles, of Edinburgh. It will be remembered that about ten or twelve years ago Mr. Robb presented his file of the "JOURNAL" to a public library—I forget where, but think it was in Edinburgh.

The Dumfries Gas Commissioners have contracted for 6120 tons of coal for the current year, at the price of £5982, or equal to 19s. 6 59d. per ton. The good quality of the purchase will be seen when it is stated that there is included 1120 tons of best cannel, 1000 tons of Hartley, 1000 tons of Cadzow, 1500 tons of Sanquhar splint, 1000 tons of Lugar gas coal, and 500 tons of Pathhead splint. Bailie Currie, who presided, said that they had already purchased 1500 tons of Elmbank cannel; and since they bought it the price had gone up 2s. 6d. per ton. Taking into account the stock they had in hand, their coal this year would cost 22s. 3d. per ton; and the average cost per 1000 cubic feet would be 2s. 2d. The increase in price over the previous year was 4s. 9½d. per ton. Altogether, the Commissioners seem to have made very favourable terms for their coal supply. Last year, the average illuminating power was from 25 to 26 candles, and in the winter time as high as 28 candles; but this year the average would be about 25 candles. There was some discussion upon the proposal to lower the illuminating power, which some of the members rather objected to; but the Committee's recommendations were adopted.

At the last meeting of the Jedburgh Town Council, a report presented

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by the Lighting Committee on the suggested electric lighting of the burgh was under consideration. Messrs. Crompton and Co., Limited, had sent in a proposal for the establishment of an electric light undertaking; and the Committee expressed the opinion that the terms offered were fair and reasonable. With regard to the prices to be charged, the Committee said they had been advised that electricity at 3d. per Board of Trade unit—the price proposed for public lighting—was equivalent to 22-candle gas at 2s. per 1000 cubic feet. The Committee had also considered the question of the Corporation themselves establishing electric light works; and they were of opinion that, in present circumstances, it was not advisable that the burgh should embark upon the scheme. On the whole, the Committee recommended that the Burgh Commissioners should adopt the scheme proposed by Messrs. Crompton and Co., and authorize them to apply for a Provisional Order to carry it out, as they were fully of opinion that a substantial saving would be effected. Bailie Young, the Convener of the Lighting Committee, in moving the adoption of the report, stated that what Messrs. Crompton proposed was that they should establish and maintain a fully-equipped electrical station, and supply light for private consumers at 7d. per unit for the first hour, equivalent to gas at 4s. per 1000 cubic feet, and for all additional current at 4d. per unit, equivalent to gas at 2s. 8d. If they combined the two, they would have an average of 6d., which was equal to 3s. 6d. per 1000 cubic feet of gas; while for heating, cooking, and motive purposes, and public lighting, the charge was to be at 3d. per unit, or equivalent to gas at 2s. per 1000 cubic feet. These charges the Committee considered to be extremely favourable compared with other places. Furthermore, Messrs. Crompton took all the risk of running the installation, whether at a profit or at a loss. If it were worked at a profit, the Corporation would be at liberty to purchase the undertaking on fair terms, as set forth in the proposals. After some discussion, the report was adopted, and the matter remitted to the Lighting Committee.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 23.

Sulphate of Ammonia.—The market remains in a lifeless condition; and there has been a further decline in values—the closing quotations being £10 15s. to £10 18s. 9d. per ton, delivered f.o.b. at the ports. Shipments continue on a moderate scale; but there has been a marked absence of new business—the disposition of buyers being to wait a still more favourable opportunity. Available supplies are becoming more plentiful. But makers seem reluctant to follow the decline in values; and there is no great pressure to sell. In the forward position, there is a fair amount of inquiry; but sellers' and buyers' ideas are too divergent to admit of much business.

Nitrate of Soda is quiet at 7s. 9d. to 8s. 1½d. per cwt., according to quality, on spot.

LONDON, *June* 23.

Tar Products.—The use of 90's benzol for gas enrichment is finding more favour from the wider diffusion of information respecting its use, and in course of time may be expected to influence its value for the better. There is a feeling of weakness in most tar products at the present moment, none of them exhibiting marked strength; but some, such as creosote, oils, and anthracene, showing rather the reverse.

The average quotations during the week are: Tar, 17s. 6d. to 28s. Pitch, east coast, 37s.; west coast, 34s. Benzol, 90's, 6d. to 8d.; special qualities for gas, 9½d.; 50's, 11d. Toluol, 1s. 2d. Solvent naphtha, 1s. 1½d. Crude naphtha, 3¾d. Heavy naphtha, 1s. Creosote, 2¼d. Heavy oils, 3d. Carbolic acid, 50's, 2s.; 60's, 2s. 7d. Naphthalene salts, drained, 33s.; pressed, 75s. Anthracene, "A," 4d.; "B," 2½d.

Sulphate of Ammonia shows a further falling off, and £10 10s. to £10 12s. 6d. per ton, less 3½ per cent., is about as much as can be obtained for early delivery.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—In the coal trade here there is no material change to note beyond a continued lessening inquiry for house-fire qualities. This restriction of the demand is in places causing the better descriptions of round coal to accumulate. But, as previously pointed out, stocks are so low that collieries are rather anxious than otherwise to replenish them during the summer months; and although from some outside districts house coal is perhaps being offered more freely, with an occasional easing in prices, local collieries are not attempting to push sales, and are very firm at recent rates. With the lessened demand for domestic purposes, there is necessarily more common round coal to dispose of for steam and forge requirements; and consumers have less difficulty in covering their needs. But there is no excess of supplies; and prices are fully maintained. In engine fuel, supplies are also more plentiful on the market, owing to outside districts sending surplus quantities into this market; but local collieries are generally moving away their output, and hold to the rates they have recently been quoting. A moderate business comes forward in the shipping trade, with fair inquiries for coastwise cargoes for next month; and prices for steam coal are steady at the Association basis. Coke continues in brisk request, with no difficulty experienced by makers in getting full late quotations. At the pit, prices may be given as: Best house coal 14s. 6d. to 15s. 6d. per ton, seconds 14s., common round coal 13s. to 13s. 6d., and engine fuel from 10s. 6d. for common to 11s. 6d. for best sorts. For delivery at the Mersey ports, steam coal is quoted at 14s. 6d. per ton for unscreened and 15s. 3d. for screened qualities. Furnace coke is about 24s. to 24s. 6d. per ton, and foundry qualities 31s. to 32s., at the ovens.

Northern Coal Trade.—Though the production of coals has been slightly reduced by local holidays, the output has on the whole been good, and has been readily taken up—the demand having been full, and showing signs of including some quantities to be put into stock. In the steam coal trade, there is a fair demand, and prices have been stiffly maintained without much change in the actual figures. Northumbrian

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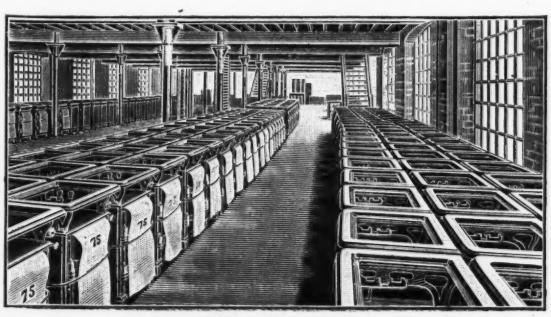

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best steam coals are 17s. 6d. to 18s. per ton f.o.b., second-class steams are about 17s., and steam smalls from 12s. 6d. to 13s. In the gas coal trade, the tendency is steady, though there does not seem to be so much inclination as there was to buy for long periods ahead. For best Durham gas coals, the quotation for occasional cargoes is 17s. per ton f.o.b.; but the bulk of the output is being disposed of on contracts that are probably from 1s. to 1s. 6d. per ton lower than the price just named. Nothing has yet been decided, as far as is known, for the supply of gas coal to Middlesbrough. In the coke trade, the demand is steady, and there is a large export; prices being firm both for blast-furnace and foundry coke. Stocks of gas coke are very low, and prices are firm; while any new contracts are at rather higher prices than those recently quoted.

Scotch Coal Trade.—The market continues strong. It is now generally believed that prices have reached their highest point, and that they will begin to come down. The closing down of works is spoken of as being necessary on account of the high price of fuel making it unprofitable to work. The effect will be that there will soon be more coal than there will be demand for, because it will not be required for productive purposes, and the pits will be crowded with workmen who will be thrown idle in other occupations. The quotations are: Main 14s. 3d. to 14s. 6d. per ton f.o.b. Glasgow, ell 16s. to 17s., and splint 16s. to 16s. 6d. The shipments for the week amounted to 222,322 tons—an increase of 21,206 tons upon the preceding week, and of 28,850 tons upon the corresponding week of last year. For the year to date, the total shipments have been 4,666,261 tons—an increase of 621,111 tons upon the same period of last year.

Brigg and Its Gas Supply.—At the meeting of the Brigg Urban District Council last week, the Finance Committee's report, which included several large items in connection with the legal and other expenses arising out of the purchase by the Council of the Brigg Gas Company's undertaking, was adopted. It was decided to apply to the Local Government Board for sanction to borrow the £1000 required for payment of compensation to officers of the Company.

Increase in the Amount Paid on a Contract.—An extraordinary result of the high price of iron is recorded at Northam, North Devon. For some time past, works of water supply have been in course of construction under a contract which was let to Messrs. Dart and Pollard. Recently the Contractors applied to the District Council for an extension of time for the completion, and also for an allowance of £1000 in excess of the contract, owing to the great increase in the price of iron. The works should be finished by November next; but the Council agreed that the time shall be extended until June, partly on account of difficulties which have been met with in the trenches. As to the additional price, it was decided last Thursday to pay the firm £1 per ton extra, not exceeding in the aggregate £1000, for all iron pipes used in carrying out the works. Mr. Littlejohns thought that in the interest of the ratepayers they ought to help the Contractors. In this opinion all the members except two concurred. Application is to be made to the Local Government Board for an additional loan to cover the cost.

Manchester Water Supply.—At last Thursday's meeting of the Water-Works Committee of the Manchester Corporation, it was decided to get out the necessary specifications and invite tenders in connection with the laying of the second pipe from Thirlmere, which was sanctioned at the last meeting of the City Council. Until the tenders have been let, it is impossible to say when the work will be commenced; but it is reported that three or four years will be occupied in putting down the pipe. Eventually, there are to be five pipes, each with a capacity to pass 10 million gallons in 24 hours. At the same meeting it was reported that the present quantity of water in store was equal to 87 days' supply.

The Position of the Aberavon Gas-Works.—Reporting on the proceedings at the meeting of the Aberavon Town Council last Wednesday, the "South Wales Daily News" says that the new Gas Manager (Mr. W. Lister) presented a report on the general state of the works on his taking over the management, which disclosed a very unsatisfactory condition of things; and he estimated the cost of immediate repairs at £102. The coal in stock when he took up the management was 92 tons short of that reported by the late Manager. The Treasurer's pass-book disclosed that a balance was due to him of over £1000. Alderman Walsh, in pursuance of notice, moved a resolution curtailing the powers of the Gas Committee in reference to the appointment of a Gas Manager in so far that the appointment should rest with the whole Council. He did not think it right that five members of any Committee should have the right to elect such an important official as a Gas Manager without the other eleven members of the Council having a voice in the matter. Mr. Wood seconded. Alderman Williams: It is nothing but a slur on the Gas Committee. Mr. Burgess supported the resolution, and disclaimed any idea of doing so as a slur upon the Committee. He concurred with Alderman Walsh's remarks. After a somewhat heated discussion, a vote was taken; and the proposition was declared carried.

Messrs. W. J. Jenkins and Co., of Retford, have received instructions from the Gaslight and Coke Company for an installation of a De Brouwer conveyor for one of their works.

A Conference between the London County Council and the Vestries and District Boards of the Metropolis will be held on Friday next, with reference to the regulations existing in connection with streets and street traffic. The Council have drawn up various suggestions relating to the regulations for the removal of house refuse, cleansing streets, the naming of streets, street cries, the traffic, and other matters; and numerous suggestions have been received from local bodies. The St. Giles District Board will ask the conference to consider whether the time has not arrived when some greater power should be vested in local bodies to control the operations of the gas, water, and other companies possessing statutory powers of breaking up the public ways. The Holborn District Board will propose that the time has arrived for concerted action on the part of the local authorities of the Metropolis to remedy the inconvenience, annoyance, and loss of time and money caused by the operations of the gas, water, telephone, and electric lighting companies in laying down and repairing their mains, pipes, services, and wires.

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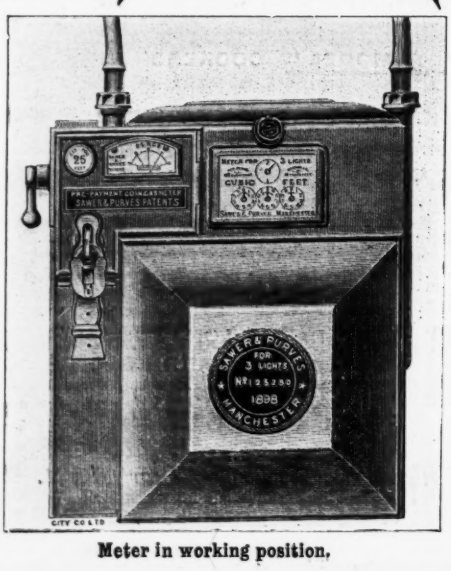

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At a special meeting of the Ipswich Town Council last Wednesday, the Electric Lighting Committee submitted a report in which they stated that the Council some time since expressed themselves as unfavourable to the adoption of the electric light for street purposes; but, at the urgent request of the Paving and Lighting Committee, the Committee had instructed Professor Kennedy to make provision for 85 arc lights, 40 of which would be alight all night. The remaining 45, the Professor suggested, might be extinguished at an hour to be agreed upon. The Deputy-Mayor (Mr. E. P. Ridley), in moving the adoption of the report, said it was simply carrying out what the Committee had been instructed by the Corporation to do. He said there was one question which deserved attention—viz., that of lighting by electricity instead of gas. As to this, he contended that the streets were not suitable for arc lamps; and he should object to them being used. Mr. Owen Turner seconded the motion. Mr. H. W. Raffe, the Chairman of the Paving and Lighting Committee, said the Committee were opposed to street lighting by electricity, owing to the increased cost. If 30 gas-lamps, situated at important positions in the town, were replaced by 18 arc lamps, they would thereby reduce a large number of gas-burners. The cost for the electric light would be about the same as that of gas now. He was well aware of the great expenditure that would be incurred by street lighting; and after the fact that Professor Kennedy had drawn attention to the large increase, no Committee would wish to adopt electric lighting for street purposes. Mr. J. Pratt strongly urged the Council to go forward in Ipswich and provide the 85 lamps proposed in the report. Mr. T. Pretty said he had had as much experience with electric light as any member of the Council, and he was of opinion that it was one of the most expensive illuminants, whether for an individual or a Corporation. He was certain that it would cost a great deal more to furnish by electricity the equivalent amount of light now supplied by gas. He moved, as an amendment, that the Council should not undertake the erection of arc lights; but this was lost. Mr. Raffe moved another amendment to the effect that 18 arc lamps should be erected in place of 30 gas-lamps at prominent positions in the centre of the town, which he indicated. Mr. Elkington expressed the opinion that such an amendment was not necessary; and it was eventually lost, and the report adopted.

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Telegraphic Addresses:
"Braddock, Oldham." "Metrique, London."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

GAS TAR wanted.

BROTHERTON AND CO., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.

Prices, &c., will be forwarded on application
No. 80, ST. ANDREW SQUARE, EDINBURGH,
NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

PATENTS FOR INVENTIONS.

Messrs. J. C. CHAPMAN & CO., Chartered Patent Agents, ADVISE ON ALL MATTERS CONNECTED WITH ABOVE.

Information and Handbook on application,
70, CHANCERY LANE, LONDON, W.C.

ENRICH your Gas with cheap Benzol. Specially prepared, free from sulphur. At to-day's Price of Benzol, ILLUMINATING POWER costs less than ONE-THIRD OF A PENNY PER CANDLE.

Apply to SADLER AND CO., MIDDLESBROUGH.

PRACTICAL RETORT SETTERS.

GEORGE NUTTALL & CO., 32, Havelock Road, Saltley, Birmingham.

Regenerator or other Furnaces erected to Engineers' own Designs. Best Work Guaranteed. Please write for Estimates.

"FRASER'S PATENT IMPROVED CAST-IRON RETORTS."

THESE Retorts have been in use many years at a large number of Gas-Works at home and abroad, and are far more durable than the plain castings.

For Terms, apply to M. WELLS AND CO., Hardman Street Works, MANCHESTER.

CLERK AND BOOK-KEEPER.

A YOUNG Man, with a knowledge of Gas Companies' Accounts, required in the Office of the Colombo Gas and Water Company, Limited, at Colombo, Ceylon. Salary Rs. 2500 per annum.

Apply, by letter, to the SECRETARY, Colombo Gas and Water Company, Limited, Gresham House, LONDON.

WANTED, a thoroughly good Foreman for a Gas-Works making nearly 50 millions.

Apply, by letter, to No. 3519, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WARE GASLIGHT AND COAL AND COKE COMPANY, LIMITED.

GAS MANAGER.

WANTED, a competent Gas Manager to take charge of Gas-Works in a Provincial Town 20 miles from London. Must thoroughly understand his business in all its Branches. Salary £120 per annum, with House, Fuel, and Light.

Applications, with *copies* of recent Testimonials, which will not be returned, to be sent to the undersigned, from whom Particulars may be obtained on application, on or before the 31st of July, 1900.

GEO. H. GISBY,
Secretary.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. SPECIAL FIRE CEMENT, OXIDE PAINTS, OILS, SULPHURIC ACID, &c.

120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

SADLER & CO., Ltd., Middlesbrough, Tar Distillers and Tar Colour Manufacturers. BENZOL specially prepared for Gas Enrichment free from Sulphur. Pure Hydrated OXIDE OF IRON for Purifying Gas either for Sale or Lent on Hire. Always Buyers of GAS TAR and AMMONIACAL LIQUOR.

WANTED, a steady Man as Stoker (Shovel Charging) for a Small Works in South Hants. Wages 25s. per week.

Apply, by letter, to No. 3520, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, Retort Setters. Must be capable men, and able to take charge and work from drawings.

Apply, stating Experience and Wages required, to JONAS DRAKE AND SON, Ovenden, HALIFAX.

WANTED, a Carbonizing Foreman for the Royal Arsenal Gas-Works, Woolwich.

Applicants must thoroughly understand the proper working of Regenerative Settings, and have been in charge of Works using this method of Carbonizing. Experience of Inclined Retorts would be considered an advantage. Make of Gas between 200 and 300 millions per annum. Wages £3 10s. per week, or £3 if House be provided.

Apply, by letter only, in own Handwriting, to the Superintendent, Building Works Department, Royal Arsenal, Woolwich, not later than the 10th of July, giving Age, Qualifications, and References.

Particulars of the Duties may be had upon application.

C. O. BOOTH,
Manager B.W.D.
for Colonel (Ret.)
Superintendent Building Works.

ENGINES and Exhausters combined "Waller," to pass 30,000 cubic feet per hour DITTO to pass 7000 feet per hour, overhauled and complete. Cheap to clear. Also BOILERS.

J. FIRTH BLAKELEY AND CO., Thornhill, DEWSBURY.

GASHOLDER, 50 ft. by 20 ft., with Six Columns, 15 inches diameter, Wrought Lattice Girders, &c., complete and perfect. About Fourteen Years old.

Price, erected, on application to J. FIRTH BLAKELEY AND CO., Thornhill, DEWSBURY.

STATION METER FOR SALE.

OFFERS wanted for Station Meter, erected in 1887, and now in good condition, but no longer required through alterations in Works. Eighteen-inch Connections; 80,000 cubic feet per hour.

Apply to C. NICKSON, Gas Department, Town Hall, Manchester.

June 21, 1900.

FOR SALE, very cheap—

WROUGHT-IRON SCRUBBER, 3 ft. 6 in. diameter by 27 ft. high, with 8-inch Bye-Pass Valves and Connections.

Five-inch Cast-Iron Vertical CONDENSER, Twelve Uprights, 20 feet or 29 feet high.

CORNISH BOILER, 4 ft. diameter, by 12 ft. long.

Apply to SAML. WHILE AND SON, 60, Queen Victoria Street, LONDON, E.C.

CONDENSERS, Washer-Scrubbers, "Cutler" patent CONDENSERS (14) 6 in. to 12 in. PIPE CONDENSERS, Patent WASHERS by "Livesey," "Holmes," and "Cockey," EXHAUSTERS up to 60,000 Cubic Feet per hour. ENGINES, BOILERS, &c. Several TOWER SCRUBBERS, PURIFIERS, METERS, GOVERNORS, PUMPS, TANKS, VALVES, &c.

J. FIRTH BLAKELEY AND CO., Gas Engineers, DEWSBURY.

FOR SALE, cheap—
Two PURIFIERS, 8 feet square, by 4 feet deep.
One EXHAUSTER and STEAM-ENGINE combined, to pass 5000 cubic feet of Gas per hour.
For further Particulars apply to the MANAGER, Gas-Works, Rothwell, YORKS.

FOR SALE—Two Lancashire Boilers, each 6 ft. diameter by 20 ft. long, with Mountings. Been in use only a short time. Made by the Yorkshire Engine Company, Limited, Sheffield.
Apply to NEWTON, CHAMBERS, & Co., LIMITED, Thorncliffe Iron-Works, near SHEFFIELD, where the Boilers may be seen.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
J. F. BLAKELEY, Gas Engineer, Thornhill, DEWSBURY.

FOR SALE—Two small Boilers, 6 feet long, 3 feet diameter, each fitted with two 9-inch Flue Tubes. Equal to new, with Fittings and Furnace Doors and Frames. Price £12 10s. each, or £22 the pair.
Also two 8-inch FLANGED T-PIECES and ELBOW CONNECTIONS, for Exhauster Bye-Pass, with Cockey and Smith's Patent Bye-Pass Valve, 4-inch Branch, and Throttle Valve and Compensator.
For further Particulars apply to the MANAGER, Gas-Works, Sandown, ISLE OF WIGHT.

THE Calne Gas and Coke Company, Limited, have FOR SALE the following APPARATUS. Offers to be sent to the Secretary at Church Street, Calne, Wilts.
All necessary CONNECTIONS for three Purifiers by Cockey and Sons, comprising;—
One Lift for 8-feet Purifier.
Four 6-inch Rack and Pinion Valves.
One 6-inch Centre-Valve with Column.
One 6-inch Bye-Pass Valve with Column.
Nineteen 6-inch Bends and Springs.
One 6-inch T-Piece.
Thirteen Caps and Clips.

RUGBY GAS COMPANY.

FOR SALE—One 20,000 cubic feet per hour WALLER THREE-BLADE EXHAUSTER, with Engine Combined, with Disc Valves, Governor, &c., complete.
One 30,000 cubic feet per hour DONKIN COMBINED ENGINE and EXHAUSTER, with Valves, Governor, &c., complete, and Bye-Pass Valve and Connections.
Both Exhausters have been working until May, and are now replaced by larger ones.
Permission to view, and any further Particulars required, to be obtained from the undersigned.
C. MEIKLEJOHN,
Engineer and Manager.

BODMIN GAS COMPANY.

THE Directors of the above Company invite TENDERS for 2000 Tons of best GAS COAL, to be delivered f.o.r. at the Gas-Works Siding, L. & S.W. Rly., in such quantities, and at such times as may be directed during the next Twelve Months, commencing July 3, 1900.
Tenders to be delivered not later than July 3, 1900, to the SECRETARY, BODMIN.

TENDERS FOR GAS COAL.

THE Directors of the Westerham Gas and Coke Company, Limited, invite TENDERS for the supply of about 500 to 600 Tons of screened GAS COAL, to be delivered to Westerham Station, in quantities of 50 Tons at the time, to suit the convenience of the Directors during the ensuing Year.
Tenders, endorsed "Tender for Coal," to be sent in by July 4.
The Directors do not bind themselves to accept the lowest or any Tender.
By order of the Directors,
C. W. HOOKER,
Secretary, *pro tem.*
Westerham.

DENTON URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

COAL.

THE Gas Committee invite Tenders for the supply of COAL, the same to be sent in on or before the 9th of July inst.
Specification and Form of Tender to be obtained from the Gas Engineer, Mr. J. Chadwick Smith, Gas-Works, Denton, near Manchester.
The Committee do not bind themselves to accept the lowest or any Tender.
By order,
WM. RICHARDS,
Clerk to the Committee.
June 22, 1900.

GLYNCORRWG URBAN DISTRICT COUNCIL.

CONSTRUCTION OF GAS-WORKS.

THE above Council invite Tenders for the erection and completion of a new GAS-WORKS, MANAGER'S DWELLING-HOUSE, and TRUNK MAIN, on a site situate at Cymmer, in the County of Glamorgan, on the Rhondda and Swansea Bay Railway, in accordance with Drawings and Specification prepared by Mr. R. A. Browning, A.M.Inst.C.E., Engineer, Neath.
The Drawings and Specification can be inspected, and all Information obtained, from the Engineer, at his Offices, Gas-Works, Neath.
Tenders, under seal, to be delivered to the undersigned, on or before the 27th inst.
CUTHBERTSON AND POWELL,
Clerks to the Council.
58, Water Street,
June 11, 1900.

TENDERS FOR GAS COAL.

THE Directors of the Ramsey Gas Com- pany (Huntingdonshire) invite TENDERS for the supply of 500 Tons of best screened GAS COAL, to be delivered during the ensuing Year, commencing in August next, in quantities monthly as may be required.
Tenders, stating Price per Ton, delivered free at Ramsey, G.N. Station, to be sent to me on or before the 5th of July next.
No Special Forms issued.
The Directors do not bind themselves to accept the lowest or any Tender.
WILLIAM ORRISS,
Secretary.
Ramsey, June 21, 1900.

MOUNTAIN ASH URBAN DISTRICT COUNCIL.

TO CONTRACTORS.

THE Council invite Tenders for the supply and erection at their Gas-Works, Penrhiwceiber, of one CORNISH BOILER, 16 by 4½ feet, and a 20,000 cubic feet per hour ROTARY EXHAUSTER and ENGINE.
Drawings and Specification may be seen, and Forms of Tender obtained on application to, Mr. J. Williams, Town Hall, Mountain Ash, on and after Monday, the 25th inst.
Sealed Tenders, prepaid and endorsed "Boiler, Exhauster, &c.," to be sent to me at or before 1 o'clock on Tuesday, the 10th of July.
The Council do not bind themselves to accept the lowest or any Tender.
It is particularly requested that all Tenders be endorsed.
By order,
H. P. LINTON,
Clerk to the Council.
Town Hall, Mountain Ash,
June 13, 1900.

KENT WATER-WORKS.

TENDERS FOR COAL.

THE Directors of the Kent Water-Works Company invite TENDERS for the supply of SCREENINGS from the best Durham COAL, at their Pumping-Stations at Crayford, Orpington, and Wilmington, Kent, for One Year. Approximate weekly quantities: Crayford, 50 to 65 Tons; Orpington, 45 to 55 Tons; Wilmington, 70 to 90 Tons; or, alternatively, for the supply of such Coal in Cargoes, f.o.b. or alongside in the River Thames, in a bulk supply of 10,000 Tons.
The Coal must be delivered in good and proper condition, and must evaporate not less than 7 lbs. of water for each pound of Coal, and be perfectly free from slag or other mineral or earthy matter. The percentage of ash and clinker to be adopted as the agreed limit will be specified.
Payments monthly, upon Engineer's certificate.
The Directors do not bind themselves to accept the lowest or any Tender.
The Draft Contract can be inspected, and other Particulars obtained, at the Company's Offices, Mill Lane, Deptford.
Tenders, marked "Tender for Coal," to be transmitted under seal on or before Saturday, June 30, to
A. DICKSON, Junr.,
Secretary of the Company.
June 16, 1900.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to CAPITAL STOCKS, WILL BE CLOSED at Four o'clock p.m. on Tuesday, the 3rd day of July next, and WILL BE RE-OPENED immediately after the Half-Yearly General Meeting of the Company to be held on the 3rd day of August next.
By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.
Chief Office: Horseferry Road,
Westminster, S.W., June 22, 1900.

SOUTH METROPOLITAN GAS COMPANY.

SALE BY TENDER OF £30,000 THREE PER CENT. PERPETUAL DEBENTURE STOCK.

MINIMUM PRICE, £97 PER CENT.

NOTICE is Hereby Given, that it is the intention of the Directors of this Company to SELL BY TENDER £30,000 of THREE PER CENT. PERPETUAL DEBENTURE STOCK, in accordance with the Provisions of the South Metropolitan Gas Acts, 1882 and 1896.
Particulars of same, with Form of Tender, can be obtained at this Office on application to the undersigned; and Tenders must be sent in on or before Tuesday, the 10th day of July next.
The Stock will be allotted to the highest bidders; but no Tender will be accepted at a lower price than at the rate of £97 money for each £100 Debenture Stock.
By order,
FRANK BUSH,
Secretary.
Offices: 709A, Old Kent Road,
London, S.E., June 9, 1900.

NEWCASTLE-UPON-TYNE AND GATESHEAD GAS COMPANY.

SALE OF ORDINARY STOCK.

THE Directors have instructed Mr. ROBERT MACK to SELL BY AUCTION, at the Offices of the Company, Newcastle-upon-Tyne, on Wednesday, the 11th day of July, 1900, at Twelve o'clock noon,

TWENTY-FIVE THOUSAND POUNDS ORDINARY STOCK

of the Company, to be issued under the Powers of the Company's Act of 1896.
For Conditions of Sale and further Particulars, apply to the undersigned.
THOMAS WADDOM,
Secretary.
Offices: 35, Grainger Street West,
Newcastle-upon-Tyne, June 11, 1900.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.
He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.
Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
SOUTHEND WATER-WORKS COMPANY.

£2900 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Friday, June 29, at Two o'clock, in Lots.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Executrix of Mrs. Gawthorp, deceased, and other Owners.
STOCKS AND SHARES
IN THE
HARROW AND STANMORE GAS COMPANY,
HORLEY DISTRICT GAS COMPANY, LIMITED,
BARNET DISTRICT GAS AND WATER COMPANY,
WEST KENT GAS COMPANY,
WINDSOR ROYAL GASLIGHT COMPANY,

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Friday, June 29, at Two o'clock.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
SOUTH ESSEX WATER-WORKS COMPANY.

NEW ISSUE OF £5000 FOUR PER CENT. PERPETUAL DEBENTURE STOCK.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 10, at Two o'clock, in Lots.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
EAST GRINSTEAD GAS AND WATER COMPANY.

NEW ISSUE OF 500 £10 CAPITAL "C" SHARES.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, July 10, at Two o'clock precisely, in Lots.
Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

Now Ready. Price 6s.

LAW
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LONDON GAS COMPANIES

A SYNOPSIS of Public Acts affecting Gas Companies and of the Special Acts of the Metropolitan Companies, with Comments and a Short History: Including a Statement of the effects of the Conversion Acts of the GASLIGHT AND COKE COMPANY, and of the SOUTH METROPOLITAN COMPANY, and an Examination of the Capital and Loan Accounts to date of the three London Companies and of the Bills now before Parliament.

BY
T. J. BARNES,
OF THE MIDDLE TEMPLE, *Barrister-at-Law.*

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OFFICE OF THE "JOURNAL OF GAS LIGHTING," &C.,
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FROM THE INTRODUCTION OF GAS LIGHTING TO THE PRESENT TIME.

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BARRISTER-AT-LAW.
WITH A PREFACE BY
GEORGE LIVESEY, M.Inst.C.E.

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LONDONDERRY COLLIERIES,

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Yield of Gas 11,000 cubic feet per Ton of Coal as per Analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

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Gas Companies are solicited to try Samples of the

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Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

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For use in the

RECOVERY OF SULPHUR,

ALSO

Removal of last Traces of SULPHURETTED HYDROGEN in catch position.

Full Particulars on application to the Patentees:

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HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.,
CHESTERFIELD.

HOLMSIDE

GAS COALS.

Present Daily Produce over 5000 Tons.

Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation

Yield of Gas per Ton . . .	11,205 Cubic Feet.
Illuminating Power	16 $\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality)	13$\frac{3}{4}$ Cwt. per Ton.
Sulphur	A little over 1 per Cent.
Ash	Under 1 per Cent.
Tar	163 lbs. (Avoir.) per Ton.
Ammoniacal Liquor	103 lbs. (Avoir.) per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

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PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

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HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

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GAS ENGINEERS

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Manufacture & supply best quality of

Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)

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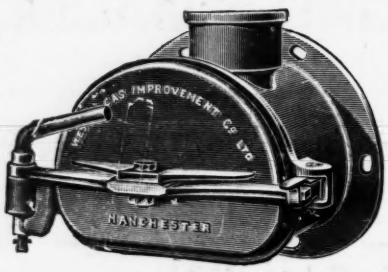

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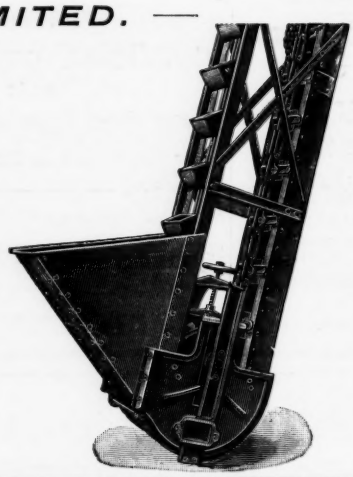

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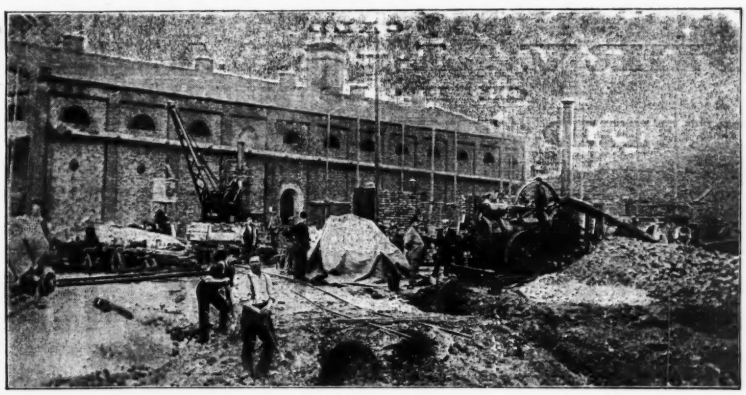

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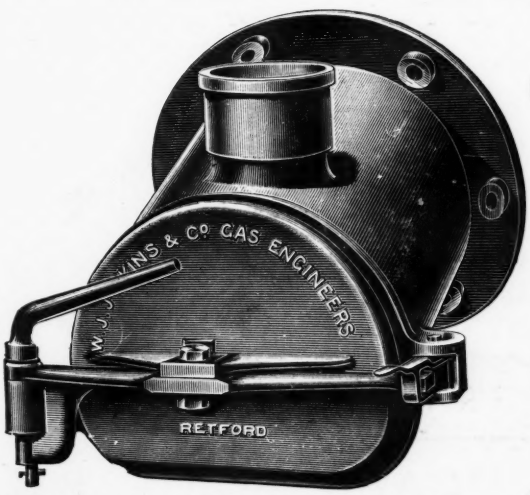

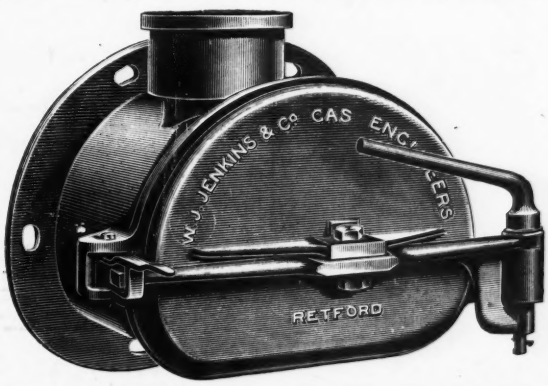

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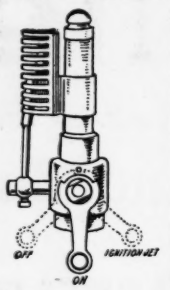

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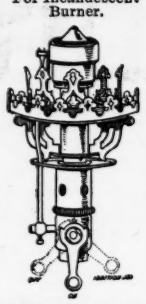

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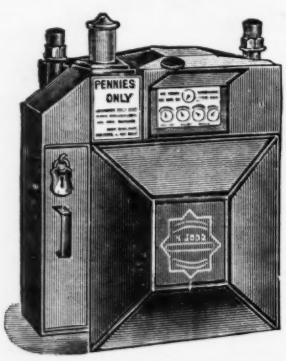

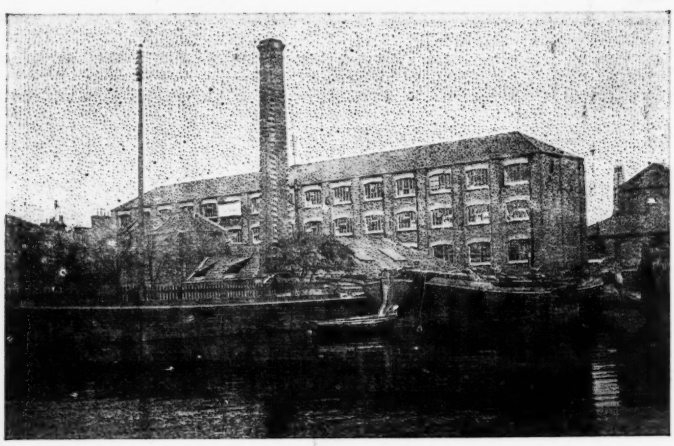

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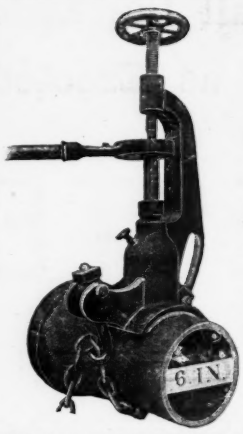

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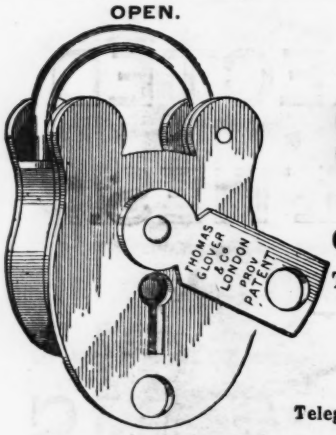

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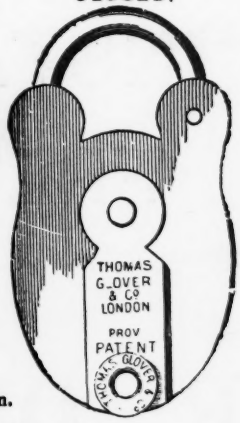

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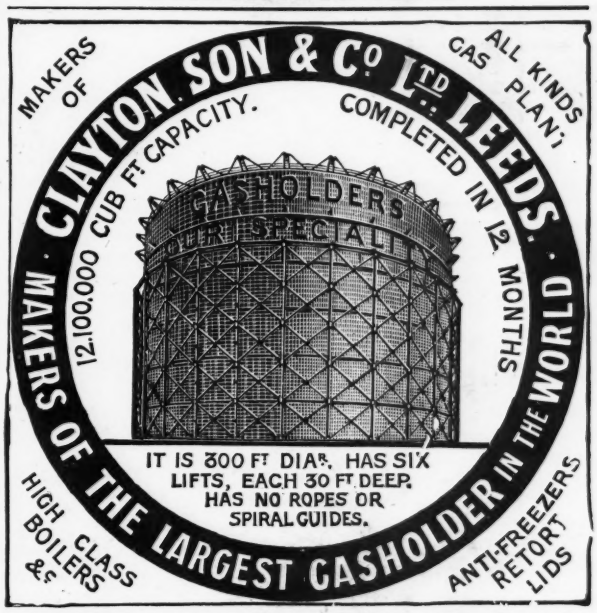
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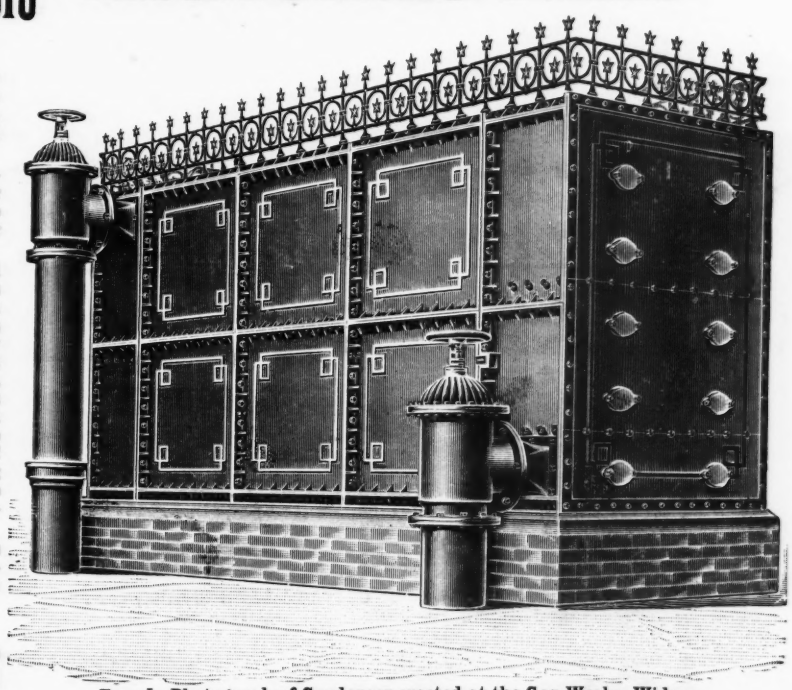

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[See also Advt. p. 1694.

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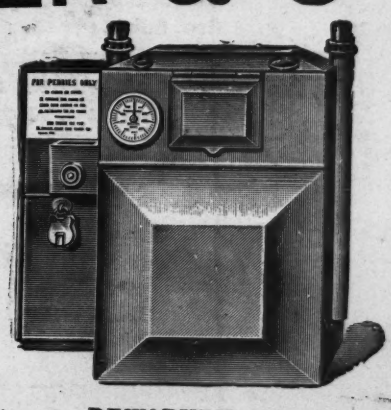

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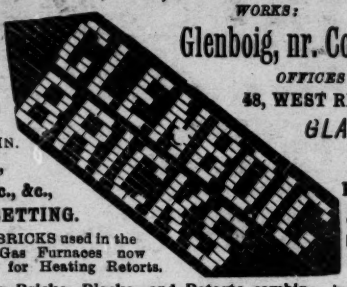

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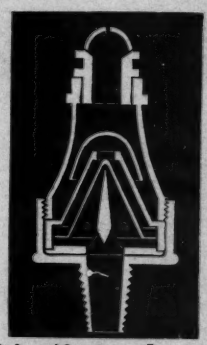

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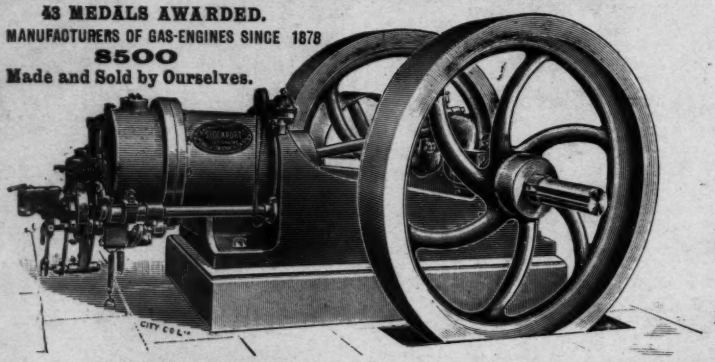

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